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The ILLUMINATING ENGINEER

THE JOURNAL OF GOOD LIGHTING

Edited by

J. STEWART DOW

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Share Your Knowledge!

GOOD Lighting is a Cause that Everyone Can Aid. We can all contribute something to the pool.

The consumer, aware of needs which the outsider may not understand nearly so well, can often give a hint to the expert. A lighting job is only fully explored when the supplier and the user put their heads together.

Do not undervalue the views of the man who pays the bill, nor be chary of imparting your knowledge in terms that he can understand.

Mr. Hibben, in his recent address to the Illuminating Engineering Society, urged lighting engineers not to make a mystery of illuminating engineering; not to imply that they form a sort of priesthood with exclusive knowledge beyond the ken of ordinary folk.

Lighting experts, too, should share their knowledge with each other. No doubt there *are* business secrets. But it is usually those who know most who will tell most.

It is the man of limited mind and small knowledge who hugs his precious secrets and suspects that those around him are out to steal his notions.

His attitude provokes the jocular advice given to one hinting at the possession of a priceless idea, "Stick to it, Old Man—you'll never get another!"

Lighting Developments in America

Mr. S. C. Hibben's informal talk on the above subject on May 8 was an undoubted success. It brought together what was possibly the largest attendance yet recorded at a meeting of the Illuminating Engineering Society—certainly by far the "best ever" at an annual general meeting. The audience, an appreciative one, enjoyed the fine display of coloured lantern slides illustrating the spectacular lighting of the Chicago World Fair, and the exhibits of lamps, several of a type unfamiliar in this country. I think, however, that what captivated them especially was the mixture of enthusiasm and humour which enlivened Mr. Hibben's remarks. It is refreshing in these days to find someone who thoroughly believes in his work and is prepared to testify to the faith that is in him! The address was an extempore one, but it will be fully reported in the journal in due course.

Illuminating Engineering in France

Illuminating engineers in this country do not always hear as much as they would like of the doings of the *Association des Engénieurs de l'Eclairage*, in France. The compact "Annual" which the Association has issued is therefore welcome. The booklet contains particulars of the rules and membership (now about 160). We notice that Dr. Nichols, of Cornell University, and Mr. C. C. Paterson share the honour of being the only two foreign "honorary members." There are no fewer than nine committees of the Association in being, dealing with such matters as architectural lighting equipment, fixtures, standardisation of reflectors, photometric accuracy, diffusing glasses, projectors, etc. A summary of the work of the I.I.C. and of the numerous bodies in France that are in various ways interested in illumination is also included. Finally, there is a brief but useful bibliography. This annual serves to make clear the considerable amount of attention that is now being devoted to illumination in France and the variety of avenues for investigation that exist.

The Road Traffic Bill

It seems evident that the above Bill, on which we commented last month, will be considerably modified as a result of discussion in Committee. Some of the objections raised by lighting experts to the mode of defining built-up areas in terms of public lighting have been again expressed at Westminster. Mr. Oliver Stanley, the Minister of Transport, recently gave assurances in regard to certain points—for instance, that street lamps will be kept lighted during hours of darkness on all 30-m.p.h. areas, and that special signs or coloured lamp-posts will be adopted as indications that a built-up area is about to be entered. Public lighting engineers and others concerned with the arrangement of street lighting contracts seem now to have made up their minds that the Bill is not likely to affect the development of street lighting prejudicially; it seems, indeed, that the association of a speed limit with lighting may actually tend to encourage developments in some instances. Nevertheless, in principle, this association of ideas is not a very happy one, and it remains to be seen how it will work out in practice.

Signs and the London Building Act

In a recent issue some reference was made to the conflict of ideas in regard to luminous signs, and to the tangle of regulations affecting them. Mr. Baxter Greig, in "Signs," recently contributed an informative survey of the influence of the London Building Act. He recalls—what is sometimes forgotten—that present regulations in regard to size and weight are based on long experience. (In 1718 a sign in Bride Lane fell, and dragged down with it the front of the building!) What is curious is that the Act says little in regard to the materials of which signs are made or the methods of support. It is also, I believe, a fact that there are no regulations whatever bearing on the essential functions of luminous signs—e.g., setting limits to colour, flicker, or brightness.

Good Industrial Lighting No. 4

Courtesy The General Electric Co. Ltd.

Figure 1. A good example of lighting with diffusing fittings, free from glare. This is stated to be the largest canteen in Gt. Britain; yet, looking from end to end of the room, not a filament can be seen.

How to Avoid Glare

GLARE or dazzle may be of two forms. The commonest form is that caused by the exposure of bright sources of light within the direct range of vision. A second form is the indirect glare experienced when light from such sources is reflected into the eyes from glazed or polished surfaces.

It is mainly with the first form of glare that we now propose to deal. A very bright source placed right in front of the eyes does undoubtedly cause discomfort, and may also make it more difficult to see clearly. How bright must a source be before this trouble is experienced? Certainly a naked electric filament or gas mantle placed right in front of the eyes *does* cause glare, whereas in ordinary circumstances a candle flame does not.

A Limit to Brightness.

It is generally agreed that an object whose brightness* is not more than twice that of the candle flame, i.e., not more than 5 candle-power per square inch (which is about the brightness of a 12″ diameter opal globe enclosing a 300-watt electric incandescent lamp) can be used in practically any position in a room without causing appreciable glare.

Where diffused general lighting is adopted, therefore, it is easy to guard against glare. An interior such as that shown above sets a good example in this respect. One can look from end to end of the room without a single unscreened source of light being visible.

Any lighting fittings with a brightness substantially greater than the 5 candle-power per sq. inch should be placed high up, out of the direct range of vision. This leads us to consider another factor that influences glare—the angle at which light comes. A light immediately overhead can scarcely cause glare, for the eye is completely shielded by the eyebrow and eyelashes. Glare is most severe when the source is directly opposite the eye, and becomes less and less troublesome as the angle between the horizontal line of vision and the direction from which light is received becomes greater. For convenience, let us call this the " visual angle."† We may say then that when this visual angle is as much as 20° the glare is much reduced, and when the visual angle is as much as 30° the glare is comparatively small.

The Angle of Cut-off.

Another angle of importance in connection with glare is the " angle of cut-off " of a reflector as illustrated in Fig. 3. When sources in open reflectors are used it is of great importance that these should be well designed and not too shallow. A very shallow reflector, merely a dish, which scarcely screens the light source at all, is of little service. Its efficiency may be high, but only because it does almost nothing! It cannot influence greatly the distribution

* Note that brightness is quite distinct from the candle-power of a source. Generally speaking, even the most powerful source becomes relatively free from glare when its light is spread over a large area.

† I must plead excuse for temporarily adopting this term. Strange to say, there does not seem to be any recognised term to describe this particular angle, although it is of great moment in illuminating engineering!

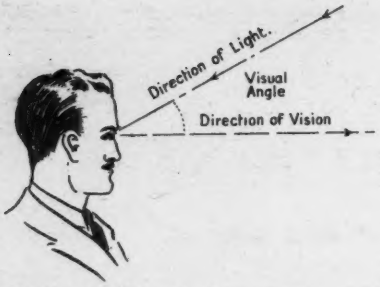

Figure 2. Glare is reduced when the angle between the direction of vision and the direction from which light comes (here called the visual angle) is made as great as possible.

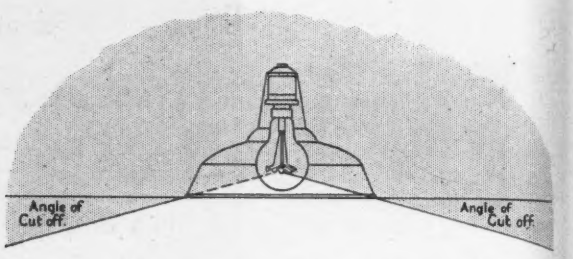

Figure 3. Illustrating the "angle of cut-off" of a Reflector.

of light, nor can it effectively screen the source from view. Generally speaking, a reflector should be deep enough to have an angle of cut-off of about 20°, and in some cases about 30° is even better.

Fig. 4 shows at a glance the advantage of using reflectors of this type. It can be seen that the visual angle, as defined above, can never be less than 20°, it will usually be more as the worker is ordinarily not gazing across the room but bending over his work. A little examination shows that with reflectors having an angle of cut-off of 20° it is scarcely possible to have serious glare. Wherever a lighting unit is put we find that one of two things must happen, either the lighting unit is outside the visual angle of 20° or the reflector completely screens the source from view. Thus we see how the choice of well designed reflectors with an adequate "angle of cut-off" simplifies design. Such units can be mounted in almost any position without danger of serious glare. Such danger is still more diminished when diffusing surfaces can be combined with reflectors, e.g., when internally frosted electric lamps are used or when vitreosil globes are fitted to incandescent gas mantles.

Care in Changing Lamps!

A little consideration also shows the importance of only using lamps for which the reflectors were designed. The substitution of a much larger bulb than that originally intended, projecting out beyond the rim of the reflector, not only causes glare but entirely spoils the distribution of light.

Local Lighting.

A word in regard to local lighting. In the case of local lamps, only a few feet distant from the eye, no half way is possible. The actual source, filament or mantle, should be *completely screened* from view by the use of an opaque shade.

Another word about background. Glare really depends not only on brightness but on contrast.

The Importance of Background.

The above limit (5 candle-power per sq. inch) holds good in average surroundings. But it must be remembered that whilst even the most glaring artificial source of light appears only mildly bright in full daylight, the light of a match, held near the eyes for a few seconds in a dark lane at night is sufficient to blind one completely. Glare from a source, therefore, is ever so much reduced when it is seen against a moderately bright background. This furnishes one more reason why walls and ceilings should be finished in a light colour.

Indirect Glare.

Indirect glare—the reflection of bright lights from glazed paper, polished metal, etc.—may usually be avoided by careful attention to the relative positions of sources of light and the shiny material they illuminate. But this form of indirect glare can also be checked by the same methods that successfully eliminate direct glare—that is, by enclosing sources in globes of diffusing glass so that their brightness (and, therefore, the brightness also of reflected images) is diminished, and by choosing light-coloured surroundings so that the contrast between these and the sources may also be less.

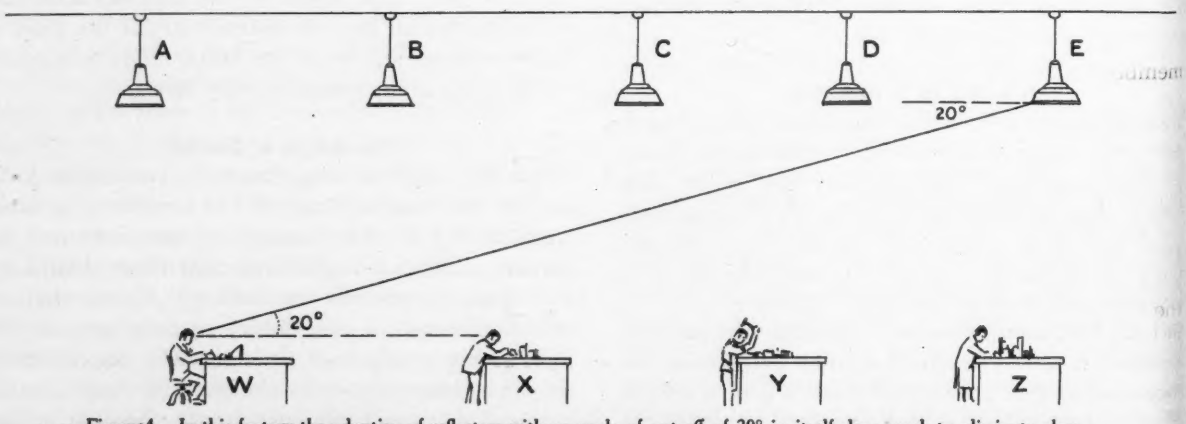

Figure 4. In this factory the adoption of reflectors with an angle of cut-off of 20° in itself does much to eliminate glare. For workers at benches X, Y, and Z the lights above are all outside the "visual angle." In the case of the worker at bench W the visual angle and the cut-off angle are identical for the furthest reflector, E. All the others (A, B, C, and D) fall outside the visual angle. Furthermore all the lighting units could be brought down to much lower levels without glare being increased—for immediately a fitting comes within the visual angle the angle of cut-off comes into play and the source of light is screened from view.

TECHNICAL SECTION

COMPRISING

Transactions of The Illuminating Engineering Society and Special Articles

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

The Illuminating Engineering Society

Annual General Meeting

(Held at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, at 6.30 p.m., on Tuesday, May 8th, 1934)

THE Annual General Meeting of the Illuminating Engineering Society was held in the Lecture Theatre of the Institution of Mechanical Engineers, on Tuesday, May 8, 1934. Members assembled for light refreshments at 6.30 p.m., and the chair was taken by the President (Mr. C. W. Sully) at 7 p.m.

After the minutes of the last Annual General Meeting had been taken as read, the Hon. Secretary read out the names of applicants for membership. In doing so he remarked that the list included the name of Mr. Hibben, the lecturer, who would be regarded as a great acquisition to the membership of the Society.

Presentation of Annual Report and Accounts.

At the request of the President, the Hon. Secretary (Mr. J. S. Dow) having first read the notice convening the meeting, presented the Annual Report of the Council (see pages 180-183). Mr. Dow explained that the report had been circulated to all members of the Society. It was therefore unnecessary to summarise its contents. He would, however, like to mention that during the past years the Society had each year recorded an increased membership and income, which he thought was encouraging during a period of industrial depression.

The President then called upon Mr. Percy Good (Hon. Treasurer) to present the Statement of Accounts for the past year. Mr. Good having read the Statement of the Auditors appearing at the foot of the Balance Sheet, said he thought that everyone would agree with him that the accounts showed steady progress. These accounts this year included as new items the records of the National Illumination Committee Fund, a fund the Society held on trust, and the International Illumination Congress Fund, which could be applied by the Society for any approved purpose.

Applicants for Membership.

Corporate Members:—

Bell, A. M. .....Tottenham and District Gas Company, Woodall House, 658, Lordship Lane, Wood Green, LONDON, N.22.

Birt, R. .....Ealing Borough Council, Electricity House, 14, Uxbridge Road, Ealing, LONDON, W.5.

Carr, W. M. .....Stretford and District Gas Board, Longford Bridge, Stretford, nr. MANCHESTER.

Hounslow, R. A. .....Falk, Stadelmann and Co., Ltd., 38, Normanby Road, Dollis Hill, LONDON, N.W.10.

King, W. E. .....238, Kingsland Road, LONDON, E.1.

Kempton, C. H. A....Stangate House, 635, Westminster Bridge Road, LONDON, S.E.1.

Sutherland, R. O. ...Architect, E.L.M.A., Lighting Service Bureau, 2, Savoy Hill, LONDON, W.C.2.

Whyte, A. J. .....James Keith and Blackman Co., Ltd., 27, Farringdon Avenue, LONDON, E.C.4.

Country Members:—

Hibben, Samuel G....Director of Lighting, Westinghouse Lamp Co., Bloomfield, New Jersey, U.S.A.

Reynolds, A. E. .....41, Great Charles Street, BIRMINGHAM.

Affiliated Students:—

Halson, L. W. .....12, Bournes Place, Battersea, LONDON, S.W.11.

Nicol, D. R. .....96, Canonbie Road, Honor Oak, LONDON, S.E.23.

Yonge, H. A. .....64, Woodland Rise, Muswell Hill, LONDON, N.10.

The names of applicants presented at the last session meeting of the Society* were read again, and these gentlemen were formally declared members of the Society.

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* Illum. Eng., May

The financial position as shown in the Balance Sheet was a very satisfactory one, and there had been some increase in subscriptions, but the continually increasing work of the Society rendered it very necessary that the membership should show a corresponding advance. He urged, therefore, that the support of more Supply Undertakings, both gas and electric, as Sustaining Members ought to be secured, and that such concerns should arrange for members of their staffs to join the Society.

The following resolution was then moved by Mr. J. G. Clark:—"That the Report of the Council for the Session 1933-34 and the Accounts of the Illuminating Engineering Society for the period from January 1, 1933 to December 31, 1933, be hereby adopted, and that a vote of thanks be extended to the President, Council, and Officers for their efforts on behalf of the Society during the past session."

In moving the resolution Mr. Clark said he had a very pleasant and easy task. Members who were afforded an opportunity of taking part in the various functions of the Society did not perhaps always realise the amount of the effort necessary to make them a success. It would take too long to review the work of the Society for the past year, but he would like to single out for special mention the visits and the development of Provincial Meetings, the reports of which have appeared in the proceedings of the Society. The success that had attended these meetings in Liverpool, Manchester, and Birmingham was largely due to the efforts of the President, who had himself attended each one. Mr. Sully would be able to look back on his year of office with pride and with satisfaction in having thus been able to arouse interest in the Society's work in these provincial centres.

Mr. Waldo Maitland briefly seconded the resolution, which was carried with acclamation.

Mr. W. R. Rawlings had much pleasure in proposing the following resolution, which was seconded by Mr. L. E. Buckell and was also carried unanimously:—

"That this meeting records its appreciation of the services of Messrs. Robert J. Ward and Company as Auditors of the Society and approves of their re-election for the next session."

Mr. Hibben's Address.

The President then called upon Mr. S. C. Hibben (Director of Lighting for the Westinghouse Lamp Company, New York City) to deliver his address reviewing "Progress in Illuminating Engineering in the United States."

Mr. Hibben, who was received with enthusiasm, gave a most entertaining and instructive address, which was illustrated by demonstrations and lantern slides. He commenced by explaining that the tendency towards using higher illuminations was paralleled by growth of interest in quality of light; and that similarly advances in technical knowledge had been accompanied by efforts to present the conception of good lighting in simple language to the public. He exhibited a number of recent forms of incandescent lamps including one particularly interesting type furnishing ultra-violet light through a black bulb which transmitted scarcely any visible light; the effect of this in causing fluorescence of impregnated fabrics was strikingly illustrated. Reference was also made to such problems as those involved in floodlighting national monuments, under-water lighting and garden lighting and a very beautiful series of coloured slides showed the lighting effects at the Chicago Fair. One leading characteristic of these decorative effects was the use of coloured light to illuminate very extensive coloured surfaces of buildings. There were also many special pillars and other lighting units of unusual design. Luminous tubes were used with striking effect for the illumination of many of the principal buildings.

Towards the end of the lecture a film was run illustrating the use of ultra-violet light in the sterilisation of water, the gradual destruction of bacteria (highly magnified) being very clearly shown

A cordial vote of thanks to Mr. Hibben, proposed by Mr. H. Hepworth Thomson (Vice-President), was carried with acclamation.

(A full account of Mr. Hibben's address will appear in a subsequent issue of the journal.)

Report of the Council for the Session, October, 1933, to May, 1934*

THE Council is happy to be able once more to report progress in the work of the Society and improvement in its position. The tendency to improvement in the industrial position, anticipated in the last report, has persisted during the past year. It is, however, worthy of note that even during the period of general depression the Society was able to maintain its membership and to increase its revenue.

ELECTION OF OFFICERS AND COUNCIL FOR NEXT SESSION.

In accordance with the procedure outlined in the Articles and By-Laws of the Society, the nominations made by the Council to fill vacancies have been published in THE ILLUMINATING ENGINEER (March, 1934, page 80) and circulated to all members, who were thus afforded an opportunity of making additional nominations, if they so desired. No new nominations having been received, those nominated by the Council are now automatically elected.

Accordingly, Mr. H. Hepworth Thompson will become President for the next session; Mr. S. B. Langlands will become Vice-President; Mr. J. S. Dow will continue as Hon. Secretary; and Mr. Percy Good will continue as Hon. Treasurer.

* Presented at the Annual General Meeting of the Illuminating Engineering Society, held in the Hall of the Institution of Mechanical Engineers (Storey's Gate, St. James's Park, London, S.W.1), at 6.30 p.m., on Tuesday, May 8, 1934.

Members will recall that Mr. J. Wyatt Ife, who had held the position of Hon. Treasurer ever since the initiation of the Society in 1909, retired at the commencement of the present Session. At the Opening Meeting Mr. Ife was presented with a silver rose bowl, bearing an inscription recording the gratitude of the Society for his long period of useful service.

The following members will fill vacancies on the Council: Mr. W. A. Bishop, Mr. H. Buckley, Mr. J. G. Clark, Mr. George Herbert, Mr. Waldo Maitland, Mr. A. B. Read and Mr. James Sellars.

WORK OF COMMITTEES.

The four main Standing Committees of the Society were constituted as follows:—

General Purposes Committee: Mr. C. W. Sully (*President*, Chairman), Mr. J. S. Dow (*Hon. Secretary*), Mr. Percy Good (*Hon. Treasurer*), Mr. A. W. Beuttell, Mr. W. J. Jones and Mr. H. Hepworth Thompson.

Papers Committee: Mr. A. Cunnington (Chairman), Mr. J. S. Dow, Mr. R. S. Downe, Mr. W. J. Jones, Mr. Howard Robertson, Mr. J. C. Walker, Dr. J. W. T. Walsh and Mr. G. H. Wilson.

Technical Committee: Mr. A. W. Beuttell (Chairman), Mr. J. S. Dow, Mr. W. J. Jones, Mr. C. A. Masterman, Mr. W. Millner, Mr. Howard Robertson, Mr. J. C. Walker, Mr. H. C. Wheat, Mr. T. E. Ritchie, Mr. G. H. Wilson. *Co-opted*: Mr. H. Buckley and Mr. H. Lingard.

Membership and Development Committee: Mr. C. W. Sully (Chairman), Mr. A. W. Beuttell, Mr. J. S. Dow, Miss C. Haslett, Mr. Cecil Hughes, Mr. W. J. Jones, Mr. Stephen Lacey and Mr. E. Stroud.

The Technical Committee has, as usual, been responsible for the preparation of the Annual Report on Progress. Certain of its members continue to furnish abstracts of articles on illumination and photometry that have appeared in the technical press, which appear monthly in the Journal, under the heading "Literature on Lighting." The main problem before the Committee, i.e., that of devising a method of determining the illumination necessary for use in various classes of buildings has been fully explained in a paper read before the Society by its originator, Mr. A. W. Beuttell. Further progress necessarily involves the undertaking of certain experimental work necessary to establish the underlying principles of the method, which is being initiated by a sub-committee operating under the Department of Scientific and Industrial Research.

The Technical Committee has recently formed four panels to investigate and report upon (a) Methods of Calculation of Artificial Illumination from Line and Surface Light Sources; (b) Methods of Pre-Determining the Efficiency and Surface Brightness of Lighting Equipment; (c) Errors arising from the Use of Portable Photometers with special reference to Street Lighting; and (d) the Use of Small Scale Models for the Pre-Determination of Illumination in Full Scale Installations.

All these are topics on which fuller information is greatly needed, and it is hoped that these investigations may ultimately furnish material for interesting papers to be read before the Society.

THE LEON GASTER MEMORIAL FUND.

A statement of the income and expenditure of this fund, which is now in its fourth year of operation, is appended. The third award of the Leon Gaster Premium of ten guineas was made during the past session to Mr. J. W. Ryde and Mr. B. S. Cooper for their joint contribution, entitled "The Theory and Specification of Opal Diffusing Glasses" (Part I.), read at the meeting of the Society on December 13, 1932.

MEETINGS OF THE SOCIETY.

Monthly meetings of the Society in London as usual dealt with a variety of topics, and were supplemented by several interesting visits. A feature has been the increased attention paid to special meetings in the Midlands and in the North-Western area, which are enumerated below.

At the opening meeting in London, on October 10, 1933, the presidential address was delivered by Mr. C. W. Sully, in accordance with the practice restored in the previous year, and the usual report on progress prepared by the Technical Committee was presented. The display of apparatus, including new forms of lamps and fittings, luminous signs, and photometric equipment, proved to be exceptionally extensive. It has been found that the number of interesting exhibits of this nature tends to increase year by year, with the result that the Council is now considering devoting one evening exclusively to this annual display.

At the subsequent meeting, on November 14, Major R. H. S. Mealing read an informative paper on "The Development of Aviation Lighting," in which progress up to the present data was traced and various problems now exciting attention were discussed. On December 12, a paper by Mr. A. W. Beuttell, entitled "An Analytical Basis for a Lighting Code," and explaining the ideas being explored by the Technical Committee, was presented. The paper was illustrated by numerous striking experiments, and gave rise to a particularly keen discussion. An overflow "informal meeting" for further discussion was subsequently arranged. In the course of the discussion at this special meeting a number of interesting points were raised. It is hoped to repeat the experiment next year.

The paper by Mr. A. Cunnington, entitled "Portable Lamps and their Applications," on January 9, covered new ground to many of those present, and illustrated the variety of lighting equipment with which illuminating engineers may have to deal. Mr. H. Buckley's paper on "Heterochromatic Photometry," on February 20, led to a particularly keen discussion, especially as regards its application to problems involved in the photometry of the electric discharge lamps.

Of the remaining papers those by Mr. R. O. Sutherland, on March 13, on "The Aesthetics of Electric Lighting in Architectures" and by Mr. Justus Eck, on April 10, on "The Art and Practice of Garden Illumination," both afforded opportunities for the discussion of applications of light in decorative and artistic fields. On the occasion of the annual general meeting, on May 8, the precedent set in 1933 of inviting some expert from abroad to address the Society is again to be followed. The visitor on this occasion will be Mr. S. G. Hibben, who will review "Progress in Illuminating Engineering in the United States."

VISITS.

The above meetings were supplemented by several visits. On October 24, 1933, members took part in an excursion to Southampton, where the authorities kindly afforded an opportunity of seeing over the extensive new docks. These docks were inspected in

daylight, but an opportunity was afforded subsequently of witnessing the floodlighting of certain areas by night, and the illumination by modern methods of recently constructed warehouses.

On November 28, 1933, by the courtesy of the London Power Company, Ltd., a visit to the new Battersea Power Station was arranged. The visit proved to be a popular item, and the number of applications was greatly in excess of the limiting number of the party. Permission for a second visit, to take place on May 29, has accordingly been granted.

Permission was granted by the County of London Electric Supply Company, Ltd., for another of the recently constructed super-power stations, at Barking, to be visited on April 17. This likewise proved to be an attractive item. In both cases, apart from the stations themselves, the lighting arrangements proved to be of considerable interest.

Yet another visit was arranged on March 22, when the premises of Glyn Mills and Company and Unilever House, near Blackfriars Bridge, were visited in succession. The lighting of both buildings presented features of interest, one point that attracted notice being the use of special local lighting in the former case, whereas general overhead lighting was invariably adopted in the latter.

PROGRESS IN PROVINCIAL CENTRES.

The progress in the North-West Area, where Mr. James Sellars, Public Lighting Engineer in Manchester, is acting as Hon. Secretary, has been fully maintained.

Three meetings have been held. The first of these took place on December 6, 1933, in Liverpool, where a visit to the Liverpool Docks was followed by a paper by Mr. J. S. Preston on "Dock Lighting." On January 30 a paper on "Gaseous Discharge Lamps" was read by Mr. H. R. Ruff, in Manchester, and on March 15 an address by the President, was followed by an excellent series of exhibits, in which examples of the latest forms of gas lamps and electric discharge lamps and photometric apparatus were included. All three meetings, which were attended by the President, the Hon. Secretary, and other members from London, were most successful. The prospects of ultimately establishing a local centre in this area appear promising.

On February 22 a meeting was arranged in Birmingham in connection with the British Industries Fair, when an address on "Artificial Lighting: A Vista of the Future," was read by the President.

It is hoped during next session to arrange meetings in other provincial cities similar to that held in Manchester on March 15. Experience shows that meetings of this type, in which demonstrations and exhibits illustrating progress in illuminating engineering play an important part, readily attract audiences, and quickly kindle interest in the work of the Society.

MEMBERSHIP.

The efforts of the Membership and Development Committee have been directed largely towards the organisation of meetings in provincial centres, in view of the strong feeling of the Council, efforts should be made to secure an extension of the membership of the Society in cities other than London. It is, however, also felt that the holding of periodical meetings of this nature in different parts of the country should, in any case, form an essential part of the programme of the Society. Actually, the results of efforts during the past session have been encouraging; thirty corporate members, nineteen country members, and thirteen affiliated students have been added to the list. The leaflet describing the aims of the Society, prepared in 1932, has again proved of service. A new edition of the Membership List was issued at the commencement of the session. Copies of both will be furnished on application to any members who are prepared to make use of them in approaching those likely to be interested in the work of the Society. As remarked in the 1933 Report, a considerably increased membership, especially in provincial areas, where the formation of local centres depends so greatly on a gain in supporters, remains one of the chief objects on which the attention of the Council and members should be concentrated.

AFFILIATED STUDENTS.

The attention of members is drawn specially to the new arrangement, adopted for the first time during the past session, whereby persons between the ages of sixteen and twenty-five who are undergoing training or instruction are free to join as Affiliated Students. Affiliated Students receive the journal and enjoy the privileges of attending meetings and visits, paying for so doing a subscription of only 10s. 6d. per annum. It is believed that this new arrangement only needs to be more widely known in order to attract to the Society many of the younger people, whose help will be so greatly needed in time to come.

THE ANNUAL DINNER.

The annual dinner, which was held, as customary, at the Trocadero Restaurant (Piccadilly-circus, London), on February 13, again proved to be a successful event. During recent years the number present at this pleasant function has continually increased, the 200 mark being attained for the first time in 1932, and exceeded in 1933. On the present occasion, which, incidentally, marked the halfway stage towards the jubilee of the Society, the attendance (234 according to the table-plan) was once more a record. There were present several of the "foundation members," who attended the original dinner at which it was resolved to start the Society twenty-five years ago.

The toast of "The Illuminating Engineering Society" was proposed by Mr. Henry W. Archer (Editor of the "Manchester Evening News"). The president, in responding, referred to the function of the Society of bringing together those having a "diversity of gifts but the same spirit," and to the efforts now being made to extend its influence and enhance its prestige. The toast of "The Guests" was proposed by Mr. Percy Good (hon. treasurer), and responded to by Mr. Maurice E. Webb (vice-president of the Royal Institute of British Architects). As usual, kindred societies and institutions were well represented among the guests. The remainder of the evening was pleasantly occupied by dancing and social intercourse, a new and much appreciated item being the performance of Mr. John Tilley, the well-known entertainer.

FINANCIAL POSITION.

The accounts for the past year, which have been duly audited by Robert J. Ward and Co., chartered accountants, and which are attached to the report, do not differ very greatly from those of previous years, but again afford evidence of steady progress. The income from subscriptions (which exceeded the £1,000 mark for the first time last year) again shows some improvement, and the expenditure of the Society in certain directions is somewhat less.

It will be observed that during the year the Society's holding in 3½ per cent. War Stock was increased by £200, making the total £1,000.

Statements of the National Illumination Committee Fund and the International Illumination Congress Fund, which, it will be recalled, were entrusted to the Society during the previous session, now figure in the accounts as appendices.

C. W. SULLY (*President*).
J. S. DOW (*Hon. Secretary*).

The Illuminating Engineering Society
32, VICTORIA STREET, LONDON, S.W.1

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1933.

Dr. *Cr.*

EXPENDITURE.	£ s. d.	£ s. d.
To Administration Expenses—		
Rent, Clerical Assistance, etc. ...	150 0 0	
Printing	97 3 3	
Duplicating	9 9 1	
General Expenses	71 15 11	
Hire of Halls for Meetings	23 13 6	
Reports and Lantern Operators ...	14 4 0	
Refreshments at Meetings	11 1 6	
Bank Charges	0 11 0	
Travelling Expenses	4 8 10	
Audit Fee	10 10 0	
		392 17 1
,, Annual Dinner	138 5 10	
Less Receipts	124 7 6	
		13 18 4
,, Illuminating Engineering Publishing Co., Ltd. —Share of Subscriptions		300 16 0
,, National Illumination Committee		32 0 0
,, British Standards Institution		10 10 0
,, International Illumination Congress Fund		10 10 0
,, Excess of Income over Expenditure		341 0 6
		£1,101 11 11

INCOME.	£ s. d.	£ s. d.
By Subscriptions		1,046 6 6
,, ,, outstanding (estimated)... ...		20 0 0
,, Interest on War Stock	35 0 0	
,, Interest on Deposit	0 5 5	
		35 5 5
		£1,101 11 11

BALANCE SHEET, 31st DECEMBER, 1933.

LIABILITIES.	£ s. d.	£ s. d.
Creditors		11 10 2
Subscriptions paid in advance		5 5 0
Capital Account:—		
Balance from last Account	906 13 5	
Add Excess Income over Expenditure for the year	341 0 6	
		1,247 13 11
		£1,264 9 1

ASSETS.	£ s. d.	£ s. d.
Cash at Bank—		
Current Account	143 10 7	
Deposit	73 2 0	
Cash in hand	0 18 6	
		217 11 1
£1,000 3½ per cent. Registered War Stock at cost		1,026 18 0
Subscriptions Outstanding		20 0 0
		£1,264 9 1

LEON GASTER MEMORIAL FUND ACCOUNT, 31st DECEMBER, 1933.

	£ s. d.	£ s. d.
Fund at the beginning of the year		252 15 2
War Stock Interest		8 1 0
		£260 16 2

	£ s. d.	£ s. d.
Expended during the year:—		
Premium for 1933/34		10 10 0
Balance:—		
Cash at Bank	13 13 0	
Invested in £230 3½ per cent. Registered War Stock at cost	236 13 2	
		250 6 2
		£260 16 2

NATIONAL ILLUMINATION COMMITTEE FUND, 31st DECEMBER, 1933.

	£ s. d.	£ s. d.
Balance transferred		372 0 0
War Stock Interest		10 10 0
		£382 10 0

	£ s. d.	£ s. d.
Balance:—		
Cash at Bank	78 1 6	
Invested in £300 3½ per cent. Registered War Stock at cost	304 8 6	
		382 10 0
		£382 10 0

INTERNATIONAL ILLUMINATION CONGRESS FUND (1931), 31st DECEMBER, 1933.

	£ s. d.	£ s. d.
Balance transferred	289 10 0	
Transfer from General Fund of Illuminating Engineering Society	10 10 0	
		300 0 0
War Stock Interest		10 10 0
		£310 10 0

	£ s. d.	£ s. d.
Balance:—		
Cash at Bank	6 1 6	
Invested in £300 3½ per cent. Registered War Stock at cost	304 8 6	
		310 10 0
		£310 10 0

We have examined the above accounts with books and vouchers, and certify same to be correct in accordance therewith, and that the Balance Sheet exhibits a true and correct view of the Society's affairs according to the information and explanations given to us.

Dated this 26th day of March, 1934.

ROBERT J. WARD & Co., *Chartered Accountants*,
10, Serjeant's Inn,
Fleet Street, London, E.C.4.

The Aesthetics of Electric Lighting in Architecture*

by R. O. SUTHERLAND, A.R.I.B.A.

THE aesthetic sense is a birthright—the response, however, is dependent upon the extent to which intuition is given play; its activity is somewhat akin to that of conscience, in that it is either exerted or suppressed. When used with discretion it can be claimed as a virtue with vital and virile qualities of an inspiring nature.

Conscience tells us infallibly how to differentiate between good and bad—while the aesthetic sense makes us conscious of whether we are or are not inspired by a design influence in building—the influence being in the case before us that of architectural lighting.

Circumstances dictate the development of the aesthete. Some have instinct sharpened as a result of contact in spheres where inspiration is the life-blood—others move in circles where the intuitive influence is discouraged, possibly by the dictates of commerce, or is restricted by practical limitations.

In order that the subject may be made clear, it will be best to analyse further what is meant by this term aesthetic; study its relation to architecture and light, and finally search for its apparently hidden influences in basic fundaments.

AESTHETICISM, ARCHITECTURE, LIGHTING.

It is contended that the aesthetic sense is a form of inspiration dependent upon knowledge and intuition, and it will assist matters if we take a common example as an illustration of how misguided most people are in the matter of interpreting what is meant by aesthetic sense.

It is common to hear the criticism that a building is apparently being supported on a sheet of glass. The finger is pointed at the architect and his aestheticism. The critic is justified (although he usually does not know it) if the façade is a period one, for, to complete the impression, it is necessary that the solid supports should be apparent. If, however, this building expresses in its elevation its structure of steel and reinforced concrete design, the critic is entirely wrong; he is, in fact, displaying his ignorance and lack of aesthetic sense, for it is known that the science of engineering and chemistry of material, makes cantilever construction possible, the supports being set back from the elevation, the glass being merely a screen with no function to support any weight.

It is unfortunate that with the increasing demand made by the specialised sciences upon the resources of the intellect that concentration on the "exact" narrows the view to the exclusion or even omission of the "aesthetic." Often the latter is subjected to destructive criticism, but as aestheticism is a form of intuition springing from natural sources, so long as there is life there will always be aesthetics, however dormant it may lie as a result of being submerged by the flood of functional influences.

As an example, it may be remarked that certain architects have tried to depend on the naked use of the ordinary pear lamp in design—in the sense of utilising a scientific element on strictly functional lines. Most attempts have been conspicuous failures. The reason is, it is here contended, in failing to permit the aesthetic sense to be exercised.

Figure 1. ST. ANDREW'S, CHEAM.

A fine example of Architectural Lighting in which there is a strong aesthetic sense. The design inspires through its architectural impression and lighting efficiency. The illumination composition is basic; technique by illuminated surfaces, the method of lighting being indirect.

The success of Architectural Lighting depends upon a correct apportionment of aesthetic essence to every problem—this varies in ratio to the purpose of a building and the exigencies of a design. For instance, there is very little aesthetic sense required in factory lighting, although one would not say that it is absent—perhaps a little more is allowed in offices—a further increase in shops, a reasonable amount in the church, an important factor in the theatres, and the strongest infusion is required in that most important of all places, the home.

Inspiration is sponsored in an atmosphere of lighting which gives a sense of ease and fitness. In this, we have to study the man in the street, for it is known that the consumer and not the producer has the last word on architectural lighting schemes. We have to appeal to him through his aesthetic sense, which springs from the root of existence. The art of living is developed with the sole aim of preserving well-being—both of mind and body. We must, therefore, in architectural lighting secure the layman's good-will through supplying his needs in both psychological and physiological spheres. It should be possible, by intensified study along these lines, to produce a high state of sensitiveness in lighting by the public.

The real problem in lighting is to make up the mind as to aim. The result of a design is the translation of an idea into the material form, and degree of success is measured in the ability of an architect to think with clarity and in terms of harmony of the materials and mediums which contribute to a finished presentation. In these deliberations economic and practical considerations are factors, but they are not generally accepted as being sufficiently powerful to compel a sense of unity in design owing to their more or less self-confined characteristics. The binding influence

* Paper read at the meeting of the Illuminating Engineering Society, held at the E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, London, W.C.2, at 6.30 p.m. on Tuesday, March 13, 1934.

is the aesthetic sense used with intuitive correctness arising from well informed inspiration.

There is, however, a weak link between thought and execution, and in architectural lighting this is sometimes unfortunately shown in the discrepancy between theory and practice. It is felt personally that this is due to faulty composition in formulating ideas as to the proportionate needs of aesthetic and scientific requirements. As these are the fundamental components directing the design, they should be blended so that harmony results and every component idea gives its best value, and the full force of a unity of understanding is brought to bear on every problem.

If it were possible to lay down some rules of the aesthetic sense which assisted in the above desire—there could be no charge that it obstructs practical requirements. Unfortunately it is impossible to state in exact terms any governing principles.

The most concrete description that could be aptly applied to the aesthetic sense is to refer to it as imparting quality of lasting performance in design.

In true design the aesthetic sense of an architect governs and moulds practical requirments from elementary stages. He has to make a compromise with a community of causes, different tastes, various skill, matters of means and special needs of many people. The ultimate result depends upon his discrimination and aptness of translation. Through all this diversity he has to preserve his purpose, which is to apply his creative faculty to the potentialities of each cause, and in the case of architectural lighting illuminating engineering is one of these causes.

The purpose of a building is not wholly contained with structural demands and planning—utility necessitates the inclusion of artificial light and it at once becomes a composte of architectural design and is subject to the same rules of conception. The ability to conceive lighting in its proper relation to satisfy illumination efficiency and the aesthetic sense is dependent upon the Architectural Lighting "mindedness" of the designer.

The architect has an inborn desire to be free to use imagination: self-preservation will not allow him to be restricted by hard-and-fast rulings in lighting which are not capable of reasonable elasticity. To work to formulae requirements would place a stranglehold on his aesthetic sense—the loss of which would make him unresponsive to the guidance of inspiration.

Although certain modifications may be made from time to time in controlling and directing ideas on lighting in response to economic needs and social causes (yet in the absence of a revolutionary change in the form of the illuminant), the general principles of architectural lighting systems are likely to be developed in reasonable accordance with present practice.

There is about us a decline of tradition due to the feeling that its restrictions are hampering, and its practice is retrogressive rather than progressive. In the absence of customary associations of form in architectural design, temerity, or a show of boldness display the lost influence of age-long canons. Reliance in design is now placed upon technique, and this responds naturally or automatically to the sensitiveness of discernment and equipment of knowledge infused with the element of forethought. The long view can only be developed by blended knowledge of all aspects both of theory and practice—such knowledge being obtained not for the purpose of evolving more systems but rather to perfect the existing, extend and establish them more firmly in the everyday life of the community.

With the universal condition in the social sphere of a revision in nearly every belief of contemporary requirements, there is provided a breeding ground for the unfettered individualist. Opportunities are liable to inflict unscrupulous lighting designs upon a bewildered public who have no traditions to guide them in the taste of the features before them. Such examples fail aesthetically because of their lack of order relation to any source of inspiration, they spring not from fundament but from a shallow egotism.

Figure 2. ROOM AT DORLAND HALL.
A splendid sample of how aesthetic feeling can be obtained by simplicity. The design has character and creates a lasting impression. The lighting is by means of an illuminated surface, a wall, the lamps being concealed behind a vertical cove.

The varied piecing of fitting parts or mere rearrangement of accepted light forms are not sufficient alone to foster development.

There is danger in trying to fix a contemporary architectural style; such a style is not apparent until

Figure 3. CUMBERLAND HOTEL, GRILL ROOM.
An interesting close-up of the Architectural light detail to the columns and beams of the Grill Room of the Cumberland Hotel. Impressionable accent introduced in a basic light composition. Aesthetic sense gives feeling of restraint and a clarity of purpose.

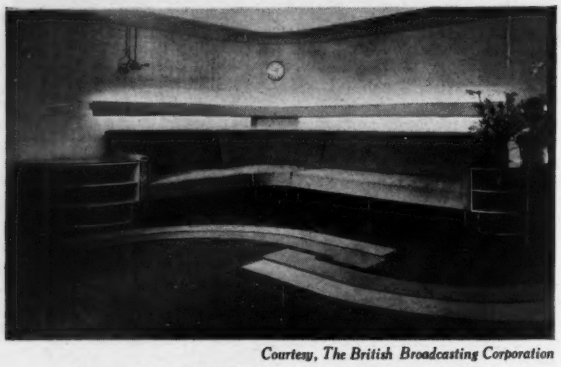
many years later. What are considered as period designs now did not exist as such at the time of their evolution, and to think of lighting to modern style is no more progressive than to period style.

Unity of impression and completeness in basic effect are ideals of the contemporary designer who has developed the right aesthetic sense. He will study the relation of light to architectural balance in design. The focal point in architectural planning becomes the centre of gravity of a composition, achieved when various factors of form, colour, and texture are relatively balanced.

Architectural lighting by intelligent use of aesthetic sense must preserve the balance of the daylight design, or, failing this, be able to create without apparent effort an entirely new set of conditions.

If a fireplace, for instance, is the dominant of a composition by day, then it should be accorded this importance by night—unless relegated by contrast to the background and another picture created which formulates itself without undue perversion of existing conditions.

Contrast is a very important element in both the scientific and aesthetic senses in architectural lighting, for it is an ever-ready reckoner in measurement of differences. There is a limit, however, to its uses, and that is in the permissibility of scale; contrast in small units, which are integral parts of a large composition, may depreciate these smaller factors to such an extent that they no longer carry their full weight in the larger issue.



Courtesy, The British Broadcasting Corporation

Figure 4. VESTIBULE AT LONDON B.B.C.

The attractiveness of a simple idea which has utilitarian character, a good illustration of aesthetic in Architectural lighting showing how design may beget future design. Lighting of walls for general purposes and local lighting for use in connection with the furniture.

It should be noted in passing from contrast that the well-trained aesthete chooses simplicity for its own sake, and the problem often is not so much " how much to put in " as " how much can be left out." The majority of us, however, find difficulty in distinguishing between severity and scantiness, and in lighting, as in other matters, we have a distinct leaning to profusion in features.

DEFINITION.

Architectural lighting has been described as systems of lighting which utilise luminous or illuminated surfaces as an essential part of the design of buildings, and where the requisite lighting equipment is either built in or on the structure as an integral part thereof.

How does this important factor of the aesthetic sense enter into this definition?

In the first place the aesthete is a devotee to system—he may term it rhythm but the sense is identically the same. We all know the pleasurable sensation of smooth running, whether it be man or machine—every component of the unit is brought into play to achieve a predetermined objective—elimination of superfluity is essential. The same characteristic is desirable in architectural lighting.

Surface is the intermediary between architecture and lighting. It represents common ground on which the engineer and architect can meet. Both have much the same interests—the desire to keep it simple, to utilise its colour and texture to make it a valuable part of a design, whether artificially lighted or not.

What is the significance of the description " built in or on "? It is that architectural lighting should be visualised and preconceived at the conception of a design. It stresses the importance of inspiration and the value of being able to think in terms of artificial light in architectural design. Furthermore, the fitting is meant to be included in these mental pictures, and not be regarded any longer as a furnishing unit.

The fact that architectural lighting is an integral part of the building implies the shouldering of responsibilities in common with concrete and steel, both scientifically and aesthetically.

COMPOSITION.

It is necessary in most cases to have a basis of light, an overall illumination sufficient for general purposes —this is known to vary in foot-candles according to the type of building. Basic light may be produced by any of the five accepted methods of lighting ranging from the totally direct to the totally indirect. As a rule, basic light is obtained by the totally indirect method, since it is claimed its characteristic as a background is in its most suitable form. Aesthetically basic light is needed to restrain contrast from being too violent.

Unrelieved basic light is correctly used and aesthetically satisfying in those cases where the value of daylight factors to a composition are not fundamentally altered by artificial light. Designs dependent chiefly upon colour or perspective would not be suited to overall washes of diffused light—as colour values would be altered and perspective liable to be flattened. Those cases relying solely upon grouping of superficial shapes would not be so susceptible to having their values distorted.

The aesthetic characteristic of basic light is repose or unity due to its singleness of method, even when it may take the form of several fittings or systems.

Decorative lighting refers to the use of various illuminating features grouped round a dominant feature in ordered relation of accent—such accent being obtained by studied contrasts in areas of surface brightnesses. No luminous or illuminated surface should be permissible which is meaningless—the introduction of an extra lighting motif should have the result of upsetting the aesthetic atmosphere—not only this but the feeling should be that of reluctance to disturb a pleasing sense of the lighting and its environment.

Schemes using decorative lighting are of two descriptions. Firstly, that which depends upon a basic light and where the decorative effect is applied in the same manner that the artist produces high-lights in a picture, secondly, that which relies solely upon the decorative lighting motives to produce the required atmosphere.

The technique of producing suitable decorative accent on a basic light background involves the use of the aesthetic sense to discriminate in the positioning of this luminous accent. Possibilities of utility may be studied, the emphasis of architectural form, focal interest, and the choosing of a dominant are vital considerations.

Purely decorative light depends upon a rhythmic organisation being established. Care must be taken to establish an efficient intensity—and the aesthetic feeling should be used to establish relationship of the illumination units with the form, colour, and texture of their setting.

No excuse is made for holding the opinion that illumination of all types of buildings should be an integral factor in the design of a structure.

Thus it is contended that offices, factories, and other less romantic spheres of activities come within the scope of architectural lighting. It is obvious that although basic or decorative light could be made effi-

cient for any purpose, the manner of presentation is unsuited to the average room where vocation is the human activity. For this reason a third category of lighting, which may be described as " vocational," is included.

This lighting fulfils aesthetic requirements when designed to give suitable intensities on a surface utilised for ocular concentration and ranges from the built-in lighting of furniture and equipment to grouped systems of office lighting.

In sharp contrast to the previous classification there is finally the fundament of fantasy lighting. It is used mostly to introduce an atmosphere, maybe gaiety, amusement, novelty, advertisement, or drama. In the grammar of architectural lighting it corresponds to the exclamation mark. In this colour plays an important part, particularly when combined with novel design. The degree of the use of light fantasy is governed by aesthetic feeling. The form generally takes the materialistic reproduction of phenomena, fantasies, and symbolic devices. They are the chief sources of inspiration; for instance, there is the artificial rainbow, the luminous creature, the coloured mass of conventionalised flowers, festoons of lighted balloons—these are examples and they can be found of great effect in exhibitions, theatrical settings, and other spheres where lighting entertains.

There is no particular ruling in fantasy motives, except to confine such expressions to the right place relative to the whole, and to impart to it that quality which will associate itself suitably as a factor of harmony, discord, or contrast in general architectural lighting conception.

It is not intended to convey the impression that these composition fundaments should be left in segregated compartments—the designer mixes them as he thinks fit. On the other hand, it would be fatal to be caught in two minds. An aim must be decided upon and carried through resolutely.

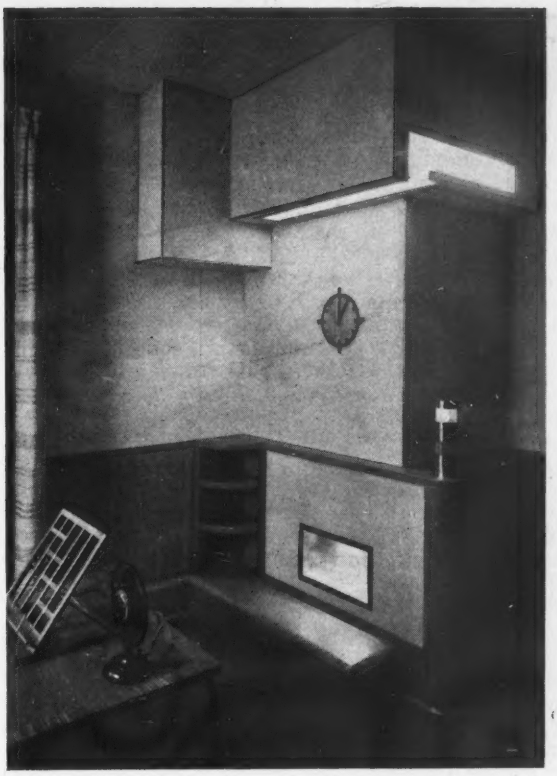


Figure 5. TALK STUDIO, B.B.C., LEEDS.
Treatment in lighting which has an aesthetic interest due partly to the unusual yet easy presentation of the light on planes both vertical and horizontal. An impression probably stamped upon memory, and the principle of the design is a likely fore-runner of other examples.

NOTATION.

We come now to those parts which are used to make up these varied compositions, such as the allocation of lighting shapes and their characteristics to particular aesthetic requirements.

Spot form includes such familiar shapes as the luminous spherical globe; disc light and cylindrical glass fittings; small round luminous panels or illuminated surfaces. Any of these forms of illumination express a sense of finality—if their use is likened to punctuation they may be said to appear as stops in the grammar of architectural lighting.

Used in series the eye is carried by flighting movements from spot to spot. Accent obtained by design in shape and intensity dictates the force of their character. Aesthetically they are used either to draw attention to certain points or break up a large expanse of plain surface. Their intensities are graded from the forceful luminous sphere through successive stages to the subdued indirectly lighted panels.

Lines may be produced by either a defined luminous or illuminated surface. They may be short and broad, imbuing a composition with basic strength, or they may be, by gradation, all those intermediate forms until the frail thin strip is reached no thicker than a chalk line.

The diversity of thicknesses is very considerable, and while the broad sweeps may be likened to the sweep of a paint brush, the thinner lines appear as the markings of a pen. The application of the line may be in horizontal, vertical, and radial directions, and to obtain the correct aesthetic sense it is necessary to visualise effect, then select that direction and thickness of luminous lines which is best suited to emphasise the purpose of a composition.

It is known, for instance, that the horizontal line can convey certain illusions and can be legitimately used to produce required effects. A square surface appears

Figure 6. WAITING ROOM, B.B.C., LEEDS.
An illustration of the use of fittings in Architectural Lighting, showing the spot form in relation to line motives on ceiling and walls; aestheticism satisfied on economic and efficiency aspects, while in design there is geometrical affinity between the form of luminaire and the setting.

higher when divided into horizontal sections—the horizontal line conveys the eye to varied distances—again, there is its marginal value when it can emphasise the shape of a room by producing the outline on a ceiling or by encircling luminous bands on walls.

The vertical line has also its specific use—it may act as an abutment to the horizontal; on a square surface a series of vertical lines gives the illusion of increased breadth, and conversely a length can be sometimes apparently shortened by a judicious use of vertical interruptions on walls or ceilings.

Radial notation is employed mostly to focus attention to a central dominant, or by means of repetitive curves to give rhythm to a scheme where it is desired to impart a sensational atmosphere; concentric radial rings about a feature invest it with an added emphasis—and this is often used about a dominant.

Pattern is a form of composition made up of either regular or irregular combinations of spot and line produced from luminous or illuminated surfaces—in one word, it is an expression of "formulation." Its use can be repetitive or static—and in architectural lighting its value in the aesthetic sense lies in its character of complexity, in varying degree. Complexity invites analysis to reach a simple solution. Patterns are sometimes compared to fanciful likenesses, and they have the ability to weave a spell of wonder on the fantasy of contrasting shapes and colours.

It has already been stated that the individual tends towards profusion—complexity is its first cousin—and on providing pattern in lighting we are playing to the tune of man's emotions, humouring him, in fact, allowing a little playful levity to relieve an age of hyper-studied correctness. In to-day's art pattern is often used, and it comes in for a good deal of criticism which to-morrow may show to be unjust.

While spot, line, and pattern all have their allotted place in the scheme of architectural lighting design, both in the aesthetic and the scientific requirements, there is yet the matter in technique of fenestration—without which any architecture is incomplete, whether it be of stone or lamp.

Fenestration is the art of balance, and it is used not only to accentuate impressions of relative masses by means of the comparison of broken to smooth surfaces, but is employed as relief to austerity (by reason of its decorative character) against the forcefulness of a background of extensive plainness. It can be likened to the lighter element necessary to heavy drama.

In illumination fenestration plays a similar role, and it is the aesthetic intuition which guides practice to include just the correct amount of relief to give balance or reveal architectural motives which are the lighter factors in a composition.

In architectural lighting design direction or diffusion is a vital consideration. The flux from a point source falling on a panel of bas relief will, for instance, set up shadows, thereby indicating a broken surface, and, incidentally, fenestration. If the illumination is completely diffused, no shadows result, and there is depreciation of the fenestration sense—the architectural accent is seen only in two dimensions, the third, giving sense in differences in plane, is lost.

The reference to dimensions introduces the subject of plain light, which acknowledges no limitations except that of the area covered by the flux from the source of projection or the extent of the surface illuminated. Its use is in direct contrast to that of fenestration and pattern, the aesthetic value being measured in the success of its simplicity, both in manner of expression and method of presentation.

Floodlighting might be described as a technique of plain illumination in exterior use. Comparatively large areas of surfaces, mostly vertical, are rendered with over-all brightness built up from systems of projectors. These floodlight units, from personal observation, seem to be awaiting the time when they will take their place in architecture. Like other applied or built-in light forms, their full value of contribution to the aesthetic feeling in design has yet to be revealed. The impressive character of plain light is derived from flux on surface without any appreciable assistance from lamp and encasing form.

As regards the interior, there are indications that a technique akin to floodlighting is becoming more used among designers, and it may be increasingly noticeable that areas of wall surfaces are being treated with washes of light, thereby fulfilling on the vertical plane that which has been deputed in the past entirely to the horizontal plane, the ceiling. The older practice referred to is that of flooding the ceiling from standards on a floor, and described as indirect lighting.

The direction of light brings one to the engineering aspects of architectural lighting—and even here it is possible to trace the aesthetic potent.

ENGINEERING ASPECTS.

There is, for instance, the selection of one or more of the five methods of lighting ranging from direct to indirect. Illuminating engineering requirements being equal, the architect must rely on the aesthetic sense to guide him as to which method to select, taking into consideration all claims of the illumination, such as use, character, effect, and cost.

To blunder at this initial stage through lack of aesthetic appreciation of a problem is a serious matter in architectural lighting, when the illumination has been built in or on to the structure as an integral part. If a designer has selected an unsatisfactory method his whole conception is in risk of becoming a failure, since composition factors of form, colour, and texture are intimately concerned.

There is, for instance, the direct system, and here is recognised its forceful concentrating characteristic, so suited to vocational light or special purpose uses. At the other end of the scale there is the indirect method, the aesthetic possibilities of which lie in its effect of giving relief to the eye, and inspiring a sense of repose.

Between the direct and indirect is the general diffusing method, presenting its light in the closest approach to pure function. The spherical flux of the bulb lamp is presented in materialistic form by the luminous globe fitting, while the cylindrical form of illuminant expresses itself in the architectural tubular lamp. Their aesthetic potentialities are great in architectural lighting, due to their simple fundamental nature. All other methods of lighting are forms of restrictions in distributing, assembling, and screening this basic general method.

As regards the semi-direct, and semi-indirect, their purpose is to moderate the contrast of the most extreme types, when the comparison between light and shade is too marked to satisfy aesthetic needs.

The method, and/or association of methods, having been visualised, it yet remains to translate them into practice—and in the process of searching for the materialistic forms with which to translate an aim recourse is made to various existing systems and analysing their aesthetic contents.

Such systems fall into three particular categories, two well known, described as built-on and built-in lighting, and the third, which is the oldest, and at the same time the newest, the lamp type—that is, certain lamps used in their naked form.

One of the built-on features is the fitting. In the design of fittings it should be stressed that the more simple the treatment the greater is its scope of application, and in this respect those units of lighting most approximating to the geometrical form are potentially the best for satisfying aesthetic feeling when used in a scheme of architectural lighting; spheres, cubes, cylinders, tubes, and so on are very adaptable. Divorced from their setting, the potential aesthetic value is judged in regard to the perfection of workmanship and the quality of material—these can be summed up at a glance, and if imperfect there is little hope of their success in the larger composition of which it is

hoped they are destined to form a part. A fitting, for instance, is almost impossible to assess in terms of aesthetic value for architectural lighting when viewed in the showroom. It lacks the fulfilment of its destiny, and for that reason its aesthetic sense is latent until it becomes an integral factor built-in or on to a structure.

If fittings are a problem to assess in aesthetic terms owing to absence of setting, very much more so is the system which is actually built-in or on to a structure. Here the shape, form, and colour is part and parcel of the structure, and no lighting feature exists like a fitting to which can be attributed separate characterestics. There is the question, however, of daylight appearance, and here there is an aesthetic difference between designs using either the luminous or illuminated surface.

The luminous surface is that form of lighting in which a translucent screen is imposed directly between the eye and the light source. There is ample vitality when it is luminous—conversely it is comparatively lifeless by day, a handicap generally to the appearance of most interiors or exteriors.

The illuminated surface does not suffer from this disability. It can usually be just as aesthetically satisfying by the light of the sun as by the light of electricity—and it has the advantage of being able to adapt itself both in form, texture, and colour with its environment, often assuming the leading role in an architectural design.

We are living now in an age when anything that can be done without is liable to be discarded. This is true of lighting. Certain light sources can now be used in their pure form—they are not encased like fittings, they are not built around like systems—they are just themselves—and aesthetically they have great force of character.

The development is not sufficient at this stage to allow pertinent observations, but on personal impressions, and realising that the swing of the pendulum will probably invest the aesthetic sense with very considerable importance in future design, it is felt that the very greatest attention should be devoted to tube forms of light.

Apart from the appearance of light, there are other factors to be taken into consideration.

We have, for instance, the utilisation factor—and this we know concerns surfaces, an important liaison between architecture and lighting. It is appreciated that the surface absorbs a proportion of flux, but it is the aesthetic sense that restrains us from treating walls and ceilings on the scientifically designed reflector principle. Perhaps, however, we could afford to encourage a bolder policy in regard to those installations where a reflector is imperative. With an effusion of aesthetic ingenuity reflectors may be used unashamed and unadorned.

There is the matter of spottiness. Spottiness in a unit and patchiness in a system destroy sense of area. Space is known to be obtained by uniformity of colour and tone, and violent interruptions on planes focus eyes to a brighter point rather than spreading vision over a smooth surface. So we have graphs showing how to obtain aesthetic satisfaction by the combinations of size and spacing of lamps by types of glazing, to give assurance of even brightness as a result of previous experiments.

Knowledge that generally the lamps have to be partially or completely enclosed results in the stipulation of a minimum area to be allowed for housing. This is for the sake of longevity of the light unit. The true aesthete recognises in these restrictions that here is the basis of a scale—a scale, that is, of form rather than light intensity. Much spottiness and poor work have been done through a designer using lamps in a feature of too small a scale—thereby causing spottiness, glare, and over-heating, with resulting discolouration—all of which are contrary to true aesthetic sense. Dirt, as well as being the enemy of the engineer, is every much as disliked by the architect. No designer makes provision for defacement by dirt; it is of paramount importance that in order to convey sense of inspiration a lighting scheme should be preserved as far as possible in the purity of its original texture and colour.

Thus very briefly is outlined the relationship of the aesthetic sense in engineering aspects, and it would seem that the scope of its influence in architectural lighting has been covered.

TERMINOLOGY.

But there is yet one very important factor. It is terminology.

It is a recognised fact, regrettable as much as it is true, that the engineer and the architect generally find the greatest difficulty in understanding each other's viewpoints. Admittedly, this is largely due to the fact that an architect may very often be deficient in engineering knowledge, while the engineer's appreciation of the architect's problem may not always be fully comprehensive. How much more misunderstanding must arise when metaphorically both professions speak in a language incapable of conveying their respective meanings.

It is probably a fact that architects on the whole are not happy with illumination terms. Lumens and foot-candles are certainly looked upon as measurement, but personally it is considered they do not register any accurate mental picture of lighting intensities or tones in architectural lighting.

There seems, personally, to be need of a volume measurement—the description of a room brimful of light, or there was a shallow amount of light, it is contended, conveys a better architectural impression of the lighting content than so many foot-candles on a plane, or a statement of the total wattage. Even experienced illuminating engineers are themselves sometimes deceived when estimating intensities dependent only on foot-candle measurement as a means of registering values.

This is not so much due to the failure of the human factor to appreciate light but to the lack of an embracing term.

As words are relied upon to describe motives, it is personally felt that in architectural lighting there is need for a common denominator acceptable to both architect and engineer. This, while descriptive of each other's particular requirements, should convey also the same value.

As a personal contribution to this problem the term " Light-Content " is put forward as a basis of understanding. The advantage of such a term is in the fact that " content " is understandable to the engineer as a measurement of quantity of, say, lumens; while the architect will be catered for by the same word expressing " content," that is, the aesthetic satisfaction of lighting in relation to the size and purpose of a space.

This " light-content " would take cognisance of cubic capacity, the total value of reflective co-efficients lumens of lamps, as well as foot-candle readings. This idea is put forward as a feeler, but with a strong belief that underlying it is a basis for finding a solution to this terminology problem, which will assist in a better understanding, both aesthetically and scientifically, in architectural lighting.

CONCLUSION.

In conclusion, let us summarise this subject of the aesthetic sense in architectural lighting. It is contended that aesthetic is an intuitive sense present in all human form, sharpened by knowledge to appreciate those relations of architecture and light which stir an emotion akin to inspiration.

This aesthetic sense is not sufficient alone as a basis of architectural lighting design, but it is a vital essence which must be infused in illumination practice. This is shown when fundamentals are analysed. It is claimed that the aesthetic sense contributes an influence in every sphere.

DISCUSSION.

Dr. S. ENGLISH said that he had read Mr. Sutherland's paper and listened to his presentation of it with the greatest pleasure and interest—which was not lessened one whit by the fact that he was still unconvinced by the case made out for the Architect in the matter of architectural lighting. This might be due to the fact that by training and experience he was entirely different from Mr. Sutherland's ideal architectural lighting designer. He had, in fact, little sympathy with the Architect who, to quote Mr. Sutherland's words, " has an inborn desire to be free to use imagination," and who looked upon the laws of good lighting as a strangle-hold on his aesthetic sense. Why should this be so in the matter of lighting and not so in the case of other sciences?

Mr. Sutherland admitted that a knowledge of engineering science made cantilever construction possible. What, therefore, would he think of an Architect who knew nothing of engineering sciences, or of the theories of mechanics, and who relied entirely on an inspiration to design a novel frontage with apparently no supports? Such an Architect would come down crash, along with his structure. Inspiration by itself was not sufficient to design anything, whether it was a building or a lighting scheme. A good knowledge of the fundamental laws of the science concerned was also necessary, in order to keep the working out of an inspiration along sound lines. It was only by keeping such an inspiration within the bounds dictated by fundamental laws that it could be converted into a good design. If these laws were not obeyed, then the result was likely to be a monstrosity, such as they were all familiar with in many forms of art. They all know of pieces of sculpture which might be the result of an inspiration. To everybody but the sculptor himself they are nightmares! We know of pieces of music which were supposed to express the composer's mood —to everybody else they were nothing but successions of discords; and alas, they also knew of architectural lighting schemes which, to everyone but their designers, were simply hideous. Mr. Sutherland said that such examples " fail because of their lack of ordered relation to any source of inspiration." He would rather say that they failed because they had disobeyed the fundamental laws of the science which underlay their particular form of art.

The obvious conclusion to the argument he put forward was, that before Architects undertake unaided the planning of lighting schemes, whether included under the heading of architectural lighting or not, they should learn something about the science of lighting. It was only after learning something of the science and its fundamental laws that the architect had that knowledge which will enable him to translate his inspirations into good art. Intuition might lead to brilliant results in a few cases of exceptionally gifted persons, but, for fully 99 per cent. of us, tuition was a much safer course to follow.

Mr. T. P. BENNETT said he wished to support the vote of thanks to the Author—all the more because he admired his courage in attempting to elucidate this difficult subject. The nature of Aesthetism was extraordinarily difficult to explain, and lighting presented difficulties not only from the point of view of design, but because it was in itself a new subject. First, one must study a problem from the scientific standpoint. One then met numerous problems arising from the construction of the building and the best method of application of light. Then came the problem of design to meet these needs. One might, however, achieve a useful design and get a fairly good result, and yet it may not be entirely satisfactory. A good construction does not entirely satisfy the average mind of an ordinary person. One must then try to find out what is missing.

He had hoped that Mr. Sutherland might have been able to frame some guiding rules in this respect. One had no method of testing a design—no form à la one could pass on to anyone else. Unlike science, art relied on the individual who had to provide the scheme. Referring to flood lighting Mr. Bennett remarked that it was a familiar experience that the results of flood lighting were considered either excellent or a failure; but this also applied to other methods of lighting. There was a great gap between a perfectly efficient scheme and a perfectly satisfactory one. He had listened to Mr. Sutherland's explanation and viewed his series of slides with much interest. He felt, however, that these illustrated the technique of the subject rather than the aestheticism. He had found that in his own practice he could take 100 examples and not find one that exactly satisfied the architectural needs.

Before a scheme could be successful it was essential to master all details. For instance, in designing a lecture hall, first of all one must consider the intensity of light required, and then the requirements of the people in regard to comfort, avoiding any effect likely to weary the eyes. When one had satisfied all these requirements one obtained a harmonious result. Satisfaction, however, implies something more than efficient lighting—something more than the provision of the right candle-power and the right kind of lamps which was difficult to define. One could take people into a theatre, and whilst the majority of them might agree that the effect of the lighting was satisfactory, the remainder would disagree. It was, in fact, difficult to please everybody. The main essentials were fitness of purpose—originality of thought—pleasing conditions to live in. One could only build upon a basis of knowledge. Results could only be achieved after an enormous amount of study. This, of course, applies to any science, but especially the science of lighting, which was so new and constantly developing.

Mr. WALDO MAITLAND said that he had found the paper of extraordinary interest. The slides had been of great value in illustrating some of the points discussed. The aesthetics of artificial lighting was a subject always difficult to discuss. He thought, however, that the question of what constituted good taste must be left to those who have had the proper training, and who had the aesthetic sense. Not everyone possessed this gift, and it was for those who were thus gifted to point out to the man in the street how this sense can be developed. Architects had a natural instinct for using light—and were responsive to the appeal which it made to the imagination. It was realised, however, that there was a lack of technical information available for reference. He himself was associated with a committee dealing with this problem. The art of applying light was developing very rapidly and it was difficult to adjust oneself to new conditions. It was so easy in practice to destroy a good effect. No doubt specific data in regard to lumens and foot-candles were invaluable in many fields, but he was not clear how they could be applied to define aesthetic impressions.

Mr. R. R. HOLMES desired to add his thanks to Mr. Sutherland for his paper. It seemed to him that it required a sense of proportion to define where the architect's work ended and that of the engineer commenced. Each had his own problems. The architect might prepare a drawing and the engineer could state if what he required was practicable, and how it could best be supplied. The difficulty was that designs and diagrams so often failed to represent the real need and intention. On one point he disagreed with the author. Mr. Sutherland had referred to the difficulty of using bare lamps. It did not seem that there would be any difficulty with lamps of the appropriate size.

Mr. J. H. BURMAN said that the aesthetic side of lighting should be regarded as an entirely new art. The illuminating engineer had a long way to go and should take a leaf from the artist's notebook. Before an artist started to paint a picture he had to master his material, and to be sure of his implements before he could put on canvas the thoughts in his mind. In learning to use his tools he was sure to produce many

monstrosities. So it was with lighting; surely a job for the specialist. It was necessary to master the materials before a really artistic effect could be produced.

Mr. H. CHEVALIER said he had listened to Mr. Sutherland's paper with much pleasure. He agreed that it was difficult to discuss a subject of this nature. In his opinion many lighting engineers did not attach sufficient importance to the psychological point of view. No lighting engineer ever seemed to be familiar with the psychology of colour! Mr. Sutherland had referred to the lighting of the Broadcasting Studio. This always made him feel as if he was surrounded by dangers—he did not know what was going to hit him first! Another thing that struck him was the coldness of the decorations. If only something could be done to make people feel more at ease in the studio, persons giving lectures would carry their audience with them and would escape that feeling of isolation. Artists were not always willing to concede that lighting is an art, as it surely is. One did, nevertheless, require a tremendous background of knowledge in handling artistic effects. Lighting engineers were inclined to forget this. He thought they should study the subject much more from the artistic side. He, like Mr. Sutherland, did not care for the term lumens, and thought " light content " was a much better definition.

Mr. JUSTUS ECK thanked Mr. Sutherland for his paper, and especially for the interesting series of pictures, of which, however, he would have liked a little more explanation. He noticed that in some cases there was only one light visible, though it was obvious that there was more lighting than this. Was it possible that the photographer had provided special light for the purpose of his exposure. He, too, thought that " light content " was a good expression.

Mr. J. S. Dow also referred to the phrase " light content," which seemed to resemble a conception recently developed in Germany (Raumhelligkeit). A statement of the flux of light in lumens did, in fact, define the light content in the room; but he imagined that what Mr. Sutherland had in mind was a summary of the aggregate effect of the brightness of the various objects and surroundings—rather a difficult thing to assess.

Criticisms of flood-lighting often overlooked the fact that effects exactly similar to those complained of were produced by natural means. He had often noticed the unreal " pasteboard " appearance of buildings seen in bright moonlight. The effect might be due in part to monotony of lighting, but he suspected that one of the chief explanations was that the background consisted of a black sky instead of a light one.

Whilst there was much that was interesting in the novel designs and lighting devices illustrated in some of Mr. Sutherland's pictures, he did not think it should be assumed that the lighting of the future should be effected *only* by such methods. Originality in design and stimulating effect was often welcome, but there were some who held that in these strenuous times one wanted something in one's home that suggested repose and restraint! It did not follow that because a thing was different it was necessarily better. A well-designed specimen of the conventional form of table-lamp seemed to him much better adapted for reading and writing than the rather singular combinations of glass and shining metal now becoming usual, which struck one as foreign elements in the average room. On the other hand, architectural lighting in the true sense, which implied harmony of the lighting elements with the design of the interior, was certainly an art with great possibilities.

Mr. HOWARD ROBERTSON (communicated): There are many points which interested me in Mr. Sutherland's exceedingly thoughtful paper, amongst these being the extension of the present tendency to flood light walls of rooms as an alternative to the ceiling. In this connection it seems to me that a demand will arise of the early service of a consultant who can assist the architect in combining the indirect lighting with a certain balance of direct light which experience the former system seems to show to be distinctly necessary to achieve local gaiety and brilliance.

A reproach which is being made to-day with regard to fittings is that the range of handsome but effective ceiling fittings is limited. A demand for elegance has arisen once more, and it is extremely difficult to find a type of ceiling fitting, say for a drawing room, or a large bedroom, which combines modern character with the elegance which, with all its disadvantages, characterises the old type of crystal chandelier, and even the early French designs of about the 1925 period. The plain functional ball, or other geometrical shape does not fully respond to certain special decorative needs.

May I add that I have rarely heard a better exposition of the aesthetic sense than that given by Mr. Sutherland, who refers to it as "imparting quality of lasting performance in design."

Mr. SUTHERLAND, replying to the discussion, said that he was in the happy position of being able to answer all the queries that had been raised. Dr. English had remarked that the use of imagination was not a prerogative of the artist, and that it was wrong not to follow hard and fast rules. He did not think that the paper conveyed this impression, and he had particularly stressed the point that one must often consider efficiency and specify lighting requirements. He had not implied that aesthetics could be expressed by definite laws, and in his concluding remarks he had referred to the aesthetics sense as not being sufficient alone as a basis of architectural lighting design, but as a vital essence which must be included in illumination practice.

He agreed with Mr. Bennett's remarks that a comprehensive knowledge of the subject was essential, and he also concurred in his view in regard to lighting technique, and especially the use of surfaces of moderate brightness.

Mr. Waldo Maitland, in referring to the light-content, had suggested that measurements of illumination in foot-candles should be quite sufficient. This was a matter of opinion. The trouble was that foot-candles varied in different places, and one could not give an exact formulae expressing the aggregate effect. (At this point some discussion took place between Mr. Bennett and Mr. Sutherland on this point, the former contending that the light-content was impossible to assess, whilst Mr. Sutherland thought that, though difficult, the task was not insuperable.)

Proceeding, Mr. Sutherland said that Mr. Holmes had somewhat misconstrued his reference to science, ignoring the aesthetic sense. What he had meant to convey was that in studying this science one became so interested in the definite object before one, that it was difficult to take a sufficiently wide view. Hence the danger that insufficient consideration might be paid to the aesthetic sense.

He was in full agreement with Mr. Chevalier's remark that lighting should be treated as an art, and likewise with Mr. Burman's contention that just as artists used their talent to produce pictures, so should one treat lighting and architecture. Here, again, he had explained in the paper that the aesthetic sense should be governed by knowledge.

There had not been time to give a more lengthy explanation of the slides as Mr. Eck desired. He would, however, be glad if Mr. Eck would pick out any slides which he thought might have involved the use of special light by the photographer.

He thought enough had already been said about the question of light-content, to which Mr. Dow had also referred. In regard to his comment in flood lighting, he might point out that moonlight came from a distant source—and distance lent enchantment. The trouble with artificial flood lighting was that one could not get the light far enough away from the building. He thought it would be found that the paper covered the question of futuristic lighting and " peace in the home."

Literature on Lighting*

(Abstracts of recent articles on Illumination and Photometry in the Technical Press)

(Continued from page 162, May, 1934)

I.—RADIATION AND GENERAL PHYSICS.

114. Electric Discharges in Gases. [(i.) Ionisation and Excitation, L. Tonks; (ii.) Ions in Dense Gases, K. K. Darrow; (iii.) Self-maintained Discharges, J. Slepian and R. C. Mason.]

Elect. Engineering, 53, *pp.* 239-243, *February; pp.* 388-395, *March; pp.* 511-518, *April*, 1934.

The initial contribution (i.) deals with fundamental physical concepts, the second (ii.) with processes taking place in an ionised gas, and the third (iii.) with current data and theories concerning various classes of self-maintained discharges, including arcs of normal and "heated cathode" types. S. S. B.

115. Note on the Experimental Determination of the Flux Emitted in a Closed Area by a Non-Point Source of Uniform Brightness. Jean Dourgnon.

R.G.E., 35, *pp.* 465-466, *April* 7, 1934.

Describes the experimental determination of flux emitted in a given area by a large source of uniform brightness, and shows a curve comparing theoretical and measured values. W. C. M. W.

116. A Distance Law Relating to the Surface Brightness and the Photometric Error with Small Radiation Intensities. H. Bertling.

Licht u. Lampe, 23, *No.* 8, *p.* 207, *April* 12; *No.* 9, *p.* 227, *April* 26, 1934.

The Lambert distance law, completed by the factor H, deduced by the author, is additionally corrected by a further factor, the ratio of the mechanical light equivalent existing for the surface brightness in question, to the mechanical light equivalent which exists with surface brightness over 2.5×10^{-4} HK/cm, and finally is related to the surface brightness instead of the intensity of illumination. Photometry below 2.5×10^{-4}HK/cm^{2}on the present basis gives errors of several hundred per cent. E. S. B-S.

117. Determination of the Distance of the Illuminant on the Basis of the Mean Value and the Lowest Value of the Illumination. E. R. Anderson.

Licht u. Lampe, 23, *No.* 9, *p.* 226, *April* 26, 1934.

A description of a graphical method for this determination. E. S. B-S.

118. Graphical Illumination Calculations. R. C. Putnam.

Gen. El. Rev., 36, *pp.* 539-544, *December*, 1933.

A set of nomogram charts for illumination calculations from isocandle diagrams, particularly for street-lighting. G. H. W.

IV.—LIGHTING EQUIPMENT.

119. New Equipment. Anon.

Elect., 112, *p.* 404, *March* 23, 1934.

A new type of motor-car headlight lamp, made with cadmium yellow glass, is now available. A yellow beam is obtained without a yellow fog screen on the headlamp. C. A. M.

120. Floodlighting Design Procedure as Applied to Modern Setback Construction. E. B. Hallman.

Am. Illum. Eng. Soc., Trans., 29, *pp.* 287-295, *April*, 1934.

The flux distribution in the beams from typical floodlights has been determined. The results are tabulated so that they may be used to estimate the average illumination obtained with various angles of floodlight tilt, when designing an installation. G. H. W.

121. Daylight Yields to Photo-Cell Control. E. H. Vedder.

El. World, 103, *pp.* 611-612, *April* 28, 1934.

The photocell control of a louvred skylight over a postal sorting-room is described. The motor-driven louvres are opened or closed as the daylight varies, the illumination below being kept approximately constant. W. C. M. W.

V.—APPLICATIONS OF LIGHT.

122. Light and Architecture. Anon.

Am. Illum. Eng. Soc., Trans. 29, *pp.* 246-266, *April*, 1934.

The results of a competition involving the decoration and lighting of a church interior are given. The lighting installations in eight modern interiors are described, with illustrations. G. H. W.

123. Can One See Better by Coloured Light? C. G. Klein.

Das Licht, 5, *pp.* 81-83, *May* 15, 1934.

Attention is drawn to the difficulty of excluding extraneous factors when studying this question. Tests should be conducted under similar conditions of illumination, and there should be a clear understanding what capacity of the eye (e.g., in detecting objects in streets) should be examined. After briefly surveying previous methods of analysis, the author describes specially designed apparatus capable of being used as a species of photometer for testing visibility in streets. Results of tests are presented

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* Abstracts are classified under the following headings: I, Radiation and General Physics; II, Photometry; III, Sources of Light; IV, Lighting Equipment; V, Applications of Light; VI, Miscellaneous. The following, whose initials appear under the items for which they were responsible, have already assisted in the compilation of abstracts: Miss E. S. Barclay-Smith, Mr. W. Barnett, Mr. S. S. Beggs, Mr. F. J. C. Brookes, Mr. H. Buckley, Mr. L. J. Collier, Mr. H. M. Cotterill, Mr. J. S. Dow, Mr. J. Eck, Dr. S. English, Dr. T. H. Harrison, Mr. C. A. Morton, Mr. G. S. Robinson, Mr. W. R. Stevens, Mr. J. M. Waldram, Mr. W. C. M. Whittle, and Mr. G. H. Wilson. Abstracts cover the month preceding the date of publication. When desired by readers we will gladly endeavour to obtain copies of journals containing any articles abstracted and will supply them at cost.—Ed.

graphically. The conclusion was drawn that light from sodium and filament lamps possessed practically equal value so far as sensitiveness of the eye to contrast is concerned. J. S. D.

124. Lighting Can be Trouble-Free. Arthur A. Brainerd.

El. World, 103, *pp.* 539-540, *April* 14, 1934.

The lighting of a weaving shed is described. The installation is stated to be of interest owing to the fact that it has been specially designed to maintain its efficiency over a period of years. W. C. M. W.

125. The Effect of Increase of Intensity of Light on the Visual Acuity of Presbyopic and non-Presbyopic Eyes. C. E. Ferree, G. Rand and E. F. Lewis.

Am. Illum. Eng. Soc., Trans. 29, *pp.* 296-313, *April*, 1934.

The visual acuity of a group of observers of various ages has been determined under illumination levels from 0.5-100 foot-candles. Some of the observers were suffering from presbyopia (lack of accommodation) usually associated with old age. Various benefits of high illumination are shown to exist. It is possible for a presbyopic observer to have the same visual acuity as a non-presbyopic observer if the illumination is increased. The original should be consulted. G. H. W.

126. Synthetic Daylight Aids Poor-Vision Pupils. W. R. Flounders.

El. World, 103, *p.* 581, *April* 21, 1934.

This article describes the artificial daylight installation in a schoolroom used by pupils whose vision is defective. Four semi-indirect units are used, each housing a 500-watt filament lamp and a 300-watt mercury-vapour lamp. The average illumination on the desk tops is 16 foot-candles, whilst that on the blackboards is 12 foot-candles. W. C. M. W.

127. Has the passing of Two Decades affected Practice in Lighting Ordinary Small Stores? A. L. Powell, J. M. Smith, and A. Rodgers.

Am. Illum. Eng. Soc., Trans. 29, *pp.* 267-286, *April*, 1934.

Data are presented covering the results of a survey to determine the sort of lighting employed by the typical small store, and comparisons are made with the results of similar surveys conducted in 1912 and 1922. G. H. W.

128. The Maintenance Engineer and Industrial Lighting. C. J. Bennett, A.I.E.E.

El. Times, 85, *p.* 443, *April* 5, 1934.

Deals with the question of general factory lighting. Several examples are given of particular problems encountered, and the article is accompanied by illustrations. W. R. S.

129. Glare-free Street Lighting with Sodium Vapour Lamps. H. Scheuermann.

Licht u. Lampe, 23, *No.* 8, *p.* 206, *April* 12, 1934.

The author describes the lighting of a road between Dallgow and Döberitz, Germany. Seventy-watt sodium vapour lamps are suspended at intervals of 20 m. and at a height of 9.5 m. An unusual feature of the system is the suspension of the lamps from a 50-mm.^{2} bronze cable, which also serves as an earthed conductor. This cable and a copper supply cable 25 mm.^{2} are slung from a network supported by 14-m. high masts at intervals of 100 m. E. S. B-S.

130. Glareless Lights for St. Paul Airport. Anon.

Elect. Engineering, 53, *p.* 497, *March*, 1934.

A brief description and photograph of the floodlighting of the runway and hangar apron at this airport. S. S. B.

131. The Lighting of the Parish Church at Oleggio. C. G. Motta.

L'Illuminazione Razionale, 2, *pp.* 34-36, *February*, 1934.

A description of methods of lighting and arrangements of circuits for the lighting of this large church. Indirect methods are largely used, and its effects are pictorially represented. J. S. D.

132. Apportioning Light and Power Units. J. R. Dunbar. *El. Times*, 85, *p.* 508, *April* 19, 1934.

An article giving a direct method for determining the number of lighting and power units consumed under a two-part tariff, using the Fawcett pattern of prepayment meter. A nomogram and several tables are given. W. R. S.

The National Physical Laboratory

Annual Report, 1933

The report of the N.P.L. for 1933 once more illustrates the extraordinary variety of work conducted at Teddington, which increases year by year. The report for 1933 contains in all 264 pages of which only a few, naturally, are devoted to photometry and illumination. One notices, however, that whilst standard work in this field is proceeding new apparatus and new applications of photometry are being continually reported. Examples are afforded by the polar curve photometer for miners' lamps and by the various illumination photometers of the photoelectric type which were submitted for test. It is interesting to hear that gas lamps and fittings tend to be submitted for examination more frequently. Some of these have been tested in the large integrating sphere. Tests of Morse signalling lamps, burning paraffin, have also been made. The photometric measurement of gaseous discharge lamps, the use of which for street lighting is now exciting so much interest, has presented the laboratory with some stiff problems.

Perhaps the most arresting statement in the Report is that relating to the national standard of length. This is in the future to be based on the wavelength of red cadmium light, which is about one forty-thousandth of an inch. Measurements in terms of this unvarying length are quite exact whereas the dimensions of material standards are certain to alter in course of time. Amongst miscellaneous researches we note the investigations on daylight lamps, on lighting for docks and aviation and on glare—the latter with special reference to motor car headlights. The glaremeter used in some of these tests is fully described and illustrated, and it is mentioned that a small form of portable brightness-meter had also been developed. Another interesting enquiry relates to the effect of small surface blemishes on sheet glass. The loss of light thus caused is quite appreciable, finger marks, for instance, reducing the transmission by about 2½ per cent.

E.A.W. Summer Programme

The Summer Programme of the Electrical Association for Women shows that informative and social meetings are agreeably blended. During the past month a visit to Messrs. W. T. Henley's Telegraph Works, Co., Ltd., and a demonstration of a new system of television by the Edison Swan Electric Co., Ltd., were arranged. On June 6 there is a visit to "Laughing Water," Cobham, where visitors will be received by the Earl and Countess of Darnley, and will inspect the all-electric restaurant and kitchens. The item announced for July 3—a lecture-demonstration of "Simple Summer Dishes and Cooling Drinks," by Miss Dorothy Vaughan—should prove a particularly timely and acceptable one.

Recent Patents

(Abstracts of recent Patents on Illumination & Photometry.)

407755. Improvements in Photo-Electric Cells.
Carl Zeiss, October 20, 1931 (*Convention, Germany*).

This specification relates to photo-electric cells of the type illuminated in a direction perpendicular to the direction of the electric current in the cell and used in conjunction with an optical filter. According to the invention the support of the cell, which is permeable to light, constitutes the optical filter. The filter may be of glass permitting the passage of only red and infra-red light. A layer of thallium sulphide is superposed upon the filter, and is covered by two electrodes, which are slightly spaced apart.

407832. Improvements in and Relating to Apparatus for Projecting Light.
Coote-Cummins, C.P., April 10, 1933.

This specification relates to apparatus for projecting an intense concentrated beam of light, as, for example, in spotlights, surgeons', etc., headlamps, vehicle lamps, and the like. The object of the invention is to confine all the light to the beam, with the minimum of scattered light. The projector comprises a rear reflector, preferably spheroidal, and a front reflector, either plain or tapered, enclosing the light source, a small aperture being formed in the front reflector, a non-reflecting portion on the inside of the rear reflector, an opaque non-reflecting screen to prevent light from the source falling directly upon the aperture, all arranged so that only divergent rays issue from the aperture, and a non-reflecting lens tube and a projecting lens mounted in front of the aperture. There is a subsidiary claim to an additional half-lens combined with the projecting lens in such manner that the beam is divided into two parts constituting in effect the lower parts only of two divergent beams.

408058. Improvements Relating to Columns or Posts for Gas Lamps.
Stewarts and Lloyds, Limited, and McMinn, E., December 3, 1932.

According to this specification a gas-lighting pole or column is itself made gas tight and is utilised as the conduit to convey the gas to the lamp, the usual gas pipe being disposed with. There are a number of subordinate claims to specific constructions.

408065. Improvements in Illuminating Fittings.
Hailward, E. A., December 13, 1932.

This specification relates to illuminant enclosures such as are used on petrol pumps, wall brackets, pendants, etc. According to the patent, in order to facilitate the decoration of the illuminant enclosure on its inside surface, it is constructed of a plurality of components which are provided by moulding with cement, liquid wood, or the like, with a rim or frame, the enclosure being formed in one operation by means of a single rim or frame or by assembling together a plurality of rims or frames, presumably each containing a component.

408099. Improvements in or relating to Electrodes for Arc Lamps.
Greider, E. C., April 18, 1933.

This specification relates to arc electrodes for the production of light rich in ultra violet, particularly between 2,800 and 3,000 A.u. According to the invention, a carbon is cored with a flame material comprising at least three of the metals, iron, manganese, titanium, and chromium. Vanadium may be used instead or as well. Carbon is preferably incorporated in the core, and an alkaline silicate may be used as a binder.

408341. Improvements in Decorative Translucent Material for Lamp Shades and the like.
The National Lighting Company, Limited, and Moses, E. A., October 18, 1932.

This specification relates to a method of making and the resultant material for lamp shades. A printed sheet or paper or like fabric is adherently secured to a card, and this combination is impregnated with mineral oil.

408366. Improvements in Prismatic Lighting Units.
Holophane, Limited, and English, S., November 9, 1932.

This specification relates to prismatic reflectors, such as are described in specifications Nos. 315114 and 380867, of the kind in which total internal reflection takes place and in which the outside surface is smooth. According to the invention, the internal faces of the prisms are formed with auxiliary light redirecting prisms, corrugations or flutes such that the direction of the ray in the glass is not altered in a vertical plane, but in the horizontal plane the rays will be refracted so as to strike the outer surface other than normally, and are consequently reflected downwards and outwards.

408419. Improvements in Directional Lighting Fittings.
The General Electric Company, Limited, Beggs, S. S., and Wilson, G. H., January, 25, 1933.

This specification relates to directional lighting fittings, such as may be used for street lighting, equipped with a linear source. According to the invention, the outer light transmitting surface of the fitting, which is large compared to the source, is fluted, the flutes being separated by distances small compared with the distance of the observer, so that the observed brightness is substantially less than that of the source, the edges of the flutes being all substantially parallel to the axis of the source. Light directing arrangements, such as prisms, etc., may be combined in the fitting.

408840. Improvements in and Relating to Electric Lighting Installations.
N. V. Philips Gloeilampenfabrieken, July 2, 1932 (*Convention, Holland*).

This specification deals with the automatic substitution of glow discharge lamps which may become imperative while on circuit. According to the invention, an incandescent lamp in series with a resistance, which permits the passage of current only when the voltage applied exceeds that across the terminals of the hot cathode gas discharge tube, is connected in shunt with the hot cathode gas discharge tube. On failure of the discharge tube, the voltage rises, and the resistance permits current to pass through the incandescent lamp. The resistance may consist of two metal plates separated by aluminium oxide.

The Lighting of Glyn Mills Bank

67 Lombard Street, London, E.C.3

Members of the Illuminating Engineering Society had an opportunity of inspecting the lighting of the above premises on March 22nd.

The thanks of the Society are due to Lord Wolverton, who personally conducted the party over the building.

THE lighting of the premises of Glyn Mills Bank, in Lombard Street, is of interest as an example of the combination of general and local lighting, and also as an instance of a commercial building in which due weight is given to *appearance* as affected by the lighting arrangements.

As one enters from Lombard Street, one is conscious of the gradual increase in brightness. From the dimly-lighted street one crosses a threshold illuminated by means of a sunk fitting incorporated in the bronze surround. Through the lobby, furnished with two indirect conch lighting fittings, and also an overhead laylight, one enters the entrance vestibule, illuminated by a concealed unit in an urn, carved out of the keystone over the doorway.

Figure 2. Main Banking Hall, showing Main Entrance.
Indirect Flood Lighting combined with individual Desk Lighting.

Figure 1. Main Banking Hall, showing Town Waste and Clearings Dept., and Ledger Dept. in rear.
Indirect Flood Lighting combined with individual Desk Lighting.

The Main Banking Hall.

One next passes into the main banking hall, an imposing interior of which Fig. 1 gives an effective impression.

Here one at once becomes conscious of the progressive increase in illumination, corresponding with the development of the architectural dimensions. The hall is lighted by four 1,000-watt and two 500-watt projector lamps mounted in special mirrored glass reflectors housed in specially designed bronze bowls. The load is about 1.35 watts per sq. ft. Overhead, at a height of 40 ft., is a laylight 20 ft. in diameter. This is illuminated by one 500-watt floodlight, carried on a catenary suspension at roof level. This unit, however, is not intended as an illuminant for the hall itself, but serves merely to light up the glass, which would otherwise appear black against the dome. The height of the crown of the main arches to the dome is 30 ft. The adjacent ledger department is lighted in a similar manner to the

Figure 3. Town Waste and Clearings Dept. at back of Main Banking Hall.
Indirect Flood Lighting combined with individual "Typerlite" Desk Lighting.

Figure 4. Town Waste and Clearings Dept. at back of Main Banking Hall.
Laylighting combined with individual Desk Lighting of the dual purpose type.

Figure 5. Public Space and General Offices, Second Floor.
Direct Unit Lighting combined with individual Desk Lighting.

banking hall by means of eight 500-watt projector lamps in bronze standards fixed to the floor. The consumption in this case is 1.5 watts per square foot, and the maximum height of the vault 23 ft., with an average general illumination of 5 foot-candles.

Special Local Lighting.

The lighting of a large number of mechanised office appliances, such as calculating machines, etc., has been effected by local methods. Specially designed "Typerlite" units of the four-light and two-light pattern have been adopted. The former, made up in one piece and mounted on one base, were so designed that a battery of four machines, two each on opposite sides of a desk, could be individually lighted and controlled. Each of the four arms is fitted with a flexible metallic top and adjustable knuckle joint and push-bar holder, so that each of the four operators can control and independently direct the light to suit his needs. A number of these units will be seen in operation in Fig. 3. All fittings of this description installed in the Bank were specially constructed for this installation. The illumination on the working plane is 8 foot-candles.

Other special features are the lighting of cashiers' desks by means of strip lights concealed in the bronze work, and the illumination of notice boards and counters by similar methods. Another device of special interest is the employment of dual purpose desk lighting where a special bronze counterweight bracket reflector can be used either for illuminating the typewriter or a special desk above it which encloses the machine when the typewriter is not in use. (See Fig. 4.) (We believe that Lord Wolverton, one of the directors, was responsible for the design of this ingenious arrangement.)

Leading off the banking hall is the partners' room, in which there is a fine example of a period fitting treated in a modern manner. This is of cut crystal, and embodies an indirect lighting unit fitted with three 150-watt lamps. It serves to illuminate the circular dome on which is inscribed historical data associated with the House.

Lighting of Upper Floors.

The general lighting of the upper floors is effected by specially designed fittings arranged to accommodate 100-200-watt lamps. The upper and lower separate glass sections are jointed together with a metal ring of small dimensions, which is hinged to allow the bottom section to be opened for lamp renewals. In general, 100-watt lamps are used, and the average consumption is about 0.65 watts per square foot. This lighting is, however, supplemented by individual desk-lighting, for which appropriate special units have been designed.

On the fourth floor we find, in the staff dining-room, rhodoid parchment-coloured shades carried on fabric covered tube suspensions, which have a restful and pleasing effect.

The Board Room.

The partners' private suite, comprising the board-room, dining-room, and three committee-rooms, occupies the fifth floor. In the board room a feature is the unusual combination of direct and indirect lighting embodied in the chandeliers (see Fig. 8), whilst in the dining-room a pleasing semi-indirect bronze fittings of special design combined with concealed

Figure 6. Cheque Clearing Department, Basement Floor.
Indirect Unit Lighting combined with individual Desk Lighting.

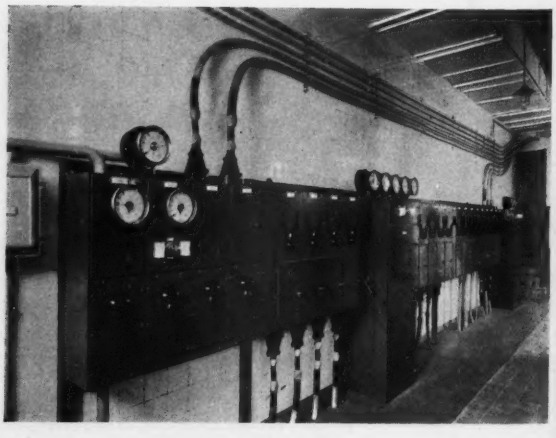

Figure 7. Engine Room showing Main Switchboard.
Direct Lighting.

Figure 8. Board Room, Fifth Floor, showing portraits of the late Lord Wolverton.
Combined Indirect and Direct Lighting, also Picture Lighting.

Figure 9. Partners' Dining Room, Fifth Floor, showing Portraits of the House Ancestors.
Semi-Indirect Lighting combined with Concealed Picture Lighting.

picture lighting are used. The three committee-rooms are each equipped with a single dish fitting of special glass carried in a light bronze work.

Patrol Corridor and Strong-Rooms.

On the vault floor, sub-vault floor, and basement floor interesting lighting is also to be seen. On the vault floor are the various strong-rooms, where the illumination of high racks of boxes by means of 25-watt lamps fitted with opal shades and mounted close to the ceiling is a feature. The patrol corridor, which encircles the whole of the strong-rooms, is illuminated by twenty-one prismatic bulkhead units, each housing a 25-watt lamp.

Cheque-Clearing Department.

In the cheque-clearing department which is located on the basement floor (Fig. 6), indirect lighting, consuming 1.8 watts per square foot, and furnishing 5-6 foot-candles, is supplemented by special individual desk lights, of a type generally adopted throughout the Bank, and which provide 7-8 foot-candles on the working plane.

The Main Switchboard.

The main switchboard, of the totally enclosed type (Fig. 7), is the first of this type used in any installation. Only the switch-operating handles are exposed. An interlocking device incorporated on each switch movement ensures that the doors cannot be opened unless the switch is in an "off" position.

Total Lighting Load.

The total lighting load of the building is approximately 90 kw. (75 kw. primary and 15 kw. secondary lighting). About 0.5 watts per square foot is expended for primary lighting, and 0.1 watt per square foot on secondary lighting, making 0.6 for the entire building.

We understand that Lord Wolverton has taken great interest in the lighting arrangements, and his co-operation proved of great assistance to the electrical contractors in ensuring that the special requirements of the Bank were satisfactorily met.

The architects for the building were Sir Herbert Baker and A. T. Scott; the consulting engineer was Dr. Oscar Faber; the electrical contractors were Messrs. Drake and Gorham, Ltd.

Lighting fittings were furnished by the following: The "Typerlite" Company; Wm. Edgar and Son; Edison Swan Electric Co., Ltd.; Osler and Faraday, Ltd.; Higgins and Griffiths, and Linolite, Ltd.

Objective Luxmeters

By H. G. Frühling

(A Report Issued by the Lighting Research Laboratory of the Osram Company, Berlin.)

I. Experience in the Use of Objective Luxmeters.

By the application of photoelectric cells of the photovoltaic type (1), the objective measurement of illumination has been extraordinarily simplified. An illumination meter of this type consists of a photovoltaic cell which is connected to a galvanometer of suitable sensitivity. While the application of these instruments seems to be very easy, a number of questions must be taken into consideration in order to get reliable results:—

1. The sensitivity of photovoltaic cells is still too low for certain purposes, especially for the measurement of outdoor illumination at night (street-lighting). The minimum illumination detectable by the instruments is about 0.1 Lux* in the case of one cell, provided that very sensitive galvanometers are used. In order to increase the sensitivity, several cells have been connected in parallel. This offers a number of disadvantages, which will be mentioned later (I.7).

2. The range of illumination intensities may be extended up to 100,000 Lux. The variation of the range is made by electrical variation of the galvanometer sensitivity (shunts, etc.). Generally, the instruments have two or three ranges (e.g., 50/250/1000 Lx), but there is no instrument which can be used for the whole range of illumination intensities from 0.1 to 100,000 Lx.

3. The sensitivity of the cells is not always constant. There is a certain decrease in sensitivity during a period after manufacture (ageing) and a temporary fatigue under the influence of high illumination intensities, especially in the case of direct sunlight.

4. The spectral response of the cells differs considerably from that of the human eye. When measuring illumination intensities produced by 100-watt gas-filled lamps of the ordinary and daylight type by means of selenium cells, Dresler (2) found a difference of 12 per cent. Compensation by means of colour filters is possible (3), but a considerable reduction of sensitivity is inevitable. Special calibration for the light in question is therefore required unless the cell is used with a correcting filter.

5. Photovoltaic cells are sensitive to temperature. In the case of selenium cells, for instance, the temperature coefficient is about 0.1 per cent. per degree (Celsius), the amount being dependent on the resistance of the galvanometer circuit. If several cells are connected in parallel, the temperature coefficient is increased. While the influence of temperature is not very great with one cell and under ordinary conditions, great differences may occur in the case of street-lighting measurements carried out during the winter-time when objective luxmeters equipped with several cells are used in order to secure sufficient sensitivity for measurements of low values of illumination. In one of these cases a difference of about 40 per cent. was found.

6. In view of this change of sensitivity, and—if no filter is used—the dependence on colour of light, which are inevitable factors in such measurements, the calibration of the instruments must be checked very carefully from time to time and for every type of light. When testing the calibration of a number of different objective luxmeters, differences of about 30 per cent. and more were found between the indication of the instrument and the illumination intensity on the surface of the cells. The value of a lux-scale is questionable, and may be misleading for the inexperienced observer. In the case of subjective luxmeters, the calibration can be readjusted by changing the current of the comparison lamp. A similar procedure is impossible in the case of objec-

* 1 Lux equals approximately 0.09 international candle. Values in lux may therefore be approximately converted into foot-candles by dividing by 10.

tive luxmeters, for a decrease in the sensitivity of the cell must be compensated by an increase of the galvanometer sensitivity. This could only be done by the manufacturer—at least, in the present state of construction.

7. The construction of the instruments is not always satisfactory. Light obstructing cell holders must be avoided on account of the cosine law. The application of several cells is inconvenient for different reasons The test plate (target) becomes very large, so that only the average illumination intensity over a certain area (that of the target) can be measured. In cases where the illumination is not uniform over this area, different readings may be obtained on account of differences in the sensitivity of the cells. Further disadvantages of cells connected in parallel are increase of temperature coefficient and sluggish deflection of the galvanometer, especially at low illumination values. For the measurement of very high illumination intensities, when it is necessary to extend the range, the surface of the cell should be covered by light-absorbing screens (opal glass, etc.). In this way a reduction of sensitivity under the influence of high illumination might be prevented. The resistance of the galvanometer should be as low as possible in order to give proportionality between illumination and current and to reduce the temperature coefficient of the cells. And as the indication of the galvanometer depends on its position (horizontal or vertical), it seems to be questionable whether the measurement of the vertical illumination could give exact value with luxmeters where the cell is directly mounted on the surface of the galvanometer.

II. Fields for Objective and Subjective Luxmeters in their Present State of Development.

A. Objective Luxmeters.

If consideration is given to the points mentioned before, objective illumination meters may be used in the following cases:—

1. For the measurement of "white" light—i.e., for illumination produced by incandescent lamps.

2. For the measurement of colour light special calibration with respect to this colour is required or the spectral sensitivity of the cell must be compensated by means of a filter. The calibration is not necessary when only the distribution of relative intensities is to be investigated. In this case, if required, the relation to absolute values may be established by simultaneous readings with objective and subjective photometers. The use of objective illumination meters may be useful in cases where extreme colour difference would offer great difficulties in heterochromatic photometry, especially for inexperienced observers and where (as in the case of street-lighting for instance) the measurement of low illumination intensities with subjective photometers would give false results on account of the Purkinje phenomenon.

3. The use of objective luxmeters is very convenient in such cases where small differences of illumination intensity are to be measured, e.g., the statement of the maximum and minimum of a distribution of illumination intensities, the adjustment of light concentration (optimum) of reflectors and the focusing of searchlights.

4. A very important field for objective luxmeters is the application for demonstration purposes, e.g. for the comparison of illumination produced by different types of lamps or luminaires, the light distribution of reflectors, the influence of absorbing media (diffusing glasses) and the cleaning of lamps and fittings. Even to a great number of observers (e.g., in schools) these effects may be demonstrated by means of objective photometers.

B. Subjective Luxmeters.

For the measurement of coloured light, the spectral energy-distribution of which is not exactly defined, objective luxmeters can only be used if the spectral sensitivity of the cell is adapted to that of the human eye by means of filters. Otherwise subjective illumination meters must be used. In the following cases the light colour is not exactly defined:—

1. Illumination with incandescent lamps, if a certain amount of the light is influenced by transmitting or reflecting surfaces of pronounced colour (coloured lamp shades, coloured walls, etc.). In this case the calibration for a special colour is not possible.

2. Illumination produced by several light sources of different colour where the composition of light varies from point to point. For instance, illumination by incandescent lamps and gas discharge lamps or illumination by daylight and artificial light.

3. Illumination furnished by sources, the spectral energy distribution of which changes during the period of measurement: Daylight illumination, especially sunlight illumination of variable intensity: Illumination from incandescent lamps, the intensity and colour of which is changed by means of a dimmer

III. Improvements in Manufacture.

The further development of objective illumination meters should comprise:

(a) Increase of the sensitivity of cells and galvanometers, and

(b) Improvement of spectral sensitivity of the cells without reducing the sensitivity.

Advice to users of such instruments should include the following hints:—

(1) The lux-readings on the scale may not always indicate the exact value of illumination on account of inevitable changes of the sensitivity of cells.

(2) Special calibration is required for coloured light if uncorrected cells are used.

(3) The value of the temperature coefficient should be given (i.e., the temperature coefficient of the complete arrangement of cells).

(4) The curve of the spectral sensitivity of the cell, in comparison with the international eye sensitivity curve, should be furnished.

(5) The colour-temperature of the light source used for calibration should be known.

IV. Knowledge and Experience Required.

Although objective illumination meters certainly offer a number of advantages over subjective luxmeters, a great deal of experience is necessary for precise measurements, at least in the present state of development. There has been a certain amount of misleading propaganda in connection with objective luxmeters—i.e., the suggestion has sometimes been conveyed that every inexperienced observer can now get reliable results with these instruments. This is by no means true. The user who has no experience in photometry requires instruction in the use of objective illumination meters in order to get really satisfactory results. Under the present conditions there should, however, be no competition between objective and subjective photometers, for both types have their advantages and their proper fields of application.

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(1) J. W. T. Walsh, "Everyday Photometry with Photoelectric Cells." Ill. Eng., 1933, Nr. 3, p. 64-72.

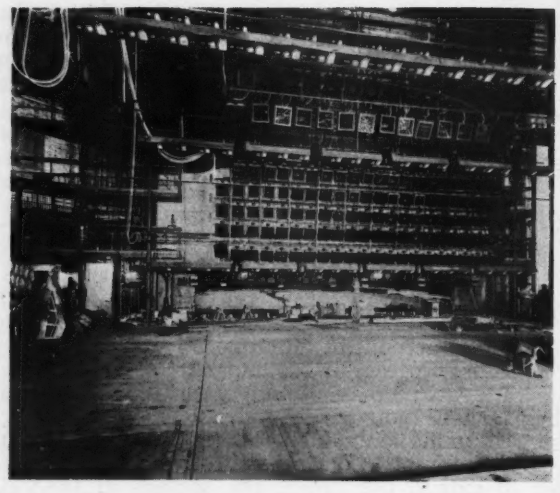
(2) A. Dresler, "Neuere Erfahrungen mit Sperrschichtzellen." Licht und Lampe, 1932, Nr. 14, S. 211-214.

(3) A. Dresler, "Uber eine neuartige Filterkombination zur genauen Angleichung der spektralen Empfindlichkeit von Photozellen an die Augenempfindlichkeitskurve." Das Licht, 1933, Nr. 2, S. 41-44.

The Royal Opera House, Covent Garden

New Stage Lighting Equipment

The whole of the Stage Lighting equipment has now been remodelled and the Opera House has now the largest and most flexible lighting equipment of any British theatre. The whole of this new apparatus was designed and made in this country in the record time of seven weeks and the contractors had possession of the stage for five weeks only.



An impressive view of the new Stage Lighting at Covent Garden Opera House, which is carried out exclusively by Osram Lamps installed in Strand Electric equipment.

The public assembled for the great "first night" at Covent Garden, to find entirely new stage lighting equipment in operation.

A feature is the gigantic semi-circular cyclorama, reaching from the grid to stage level, which enables a wonderful impression of distance to be conveyed. On this surface, for which nearly 15,000 sq. ft. of specially woven material have been used, sky, cloud, and scenery can be projected. Despite its vast size, it can be rolled up to one corner of the stage in thirty seconds. The cyclorama is lighted by two massive wrought-iron frames, hanging from the grid, and together carrying 150 1,000-watt "Sunray" lanterns, which illuminate the upper regions. A further 72 lanterns on movable trucks furnish the horizon lighting. All this lighting is done in three colours, by combining which practically any desired hue can be obtained.

The more conventional stage lighting includes footlights, five "Sunray" battens, and a lighting bridge. The battens have fitted between the sections numerous spotting, flooding, and acting area lanterns, which enable any small area on the stage to be specially treated. The lighting bridge has in all twenty-four lanterns of varied design, and there is also a battery of spotting lanterns. On three perches on each side of the proscenium there are additional spotting lamp lanterns of a type resembling that used to illuminate Nelson's Column two and a half years ago. Similar lanterns, but with the additional feature of automatic colour-changing equipment, are provided in the auditorium dome. Very comprehensive portable lighting equipment is also available.

Naturally the manipulation of all this equipment involves exceptionally complete control: yet this is effected from a switchboard platform of quite small dimensions. The dimmer bank is 34 ft. long and 8 ft. 6 in. high, but its control is assembled within a space $5\frac{3}{4}$ ft. by $2\frac{3}{4}$ ft. only. The dimmers are housed in a special chamber in the lower basement of the theatre, and are built in two sections controlling the cyclorama and colour lighting. The motive is manual, and is transmitted by some 220 ft. of steel shafting.

The possibilities of this new lighting were admirably illustrated at the display of "Der Rheingold," illustrated below.

This new, and in many respects unique, system has been installed by the Strand Electric and Engineering Co., Ltd. (directors, A. J. Earnshaw and P. Sheridan), to the requirements of the joint architects, Messrs. Hood and Huggins and Frank Matcham and their consulting engineer, Mr. Basil Davis. The whole installation was erected under the supervision of Mr. K. L. G. Applebee, who states that upwards of fifty miles of cable and some thousands of Osram lamps were used.

Courtesy, "Electric Review"

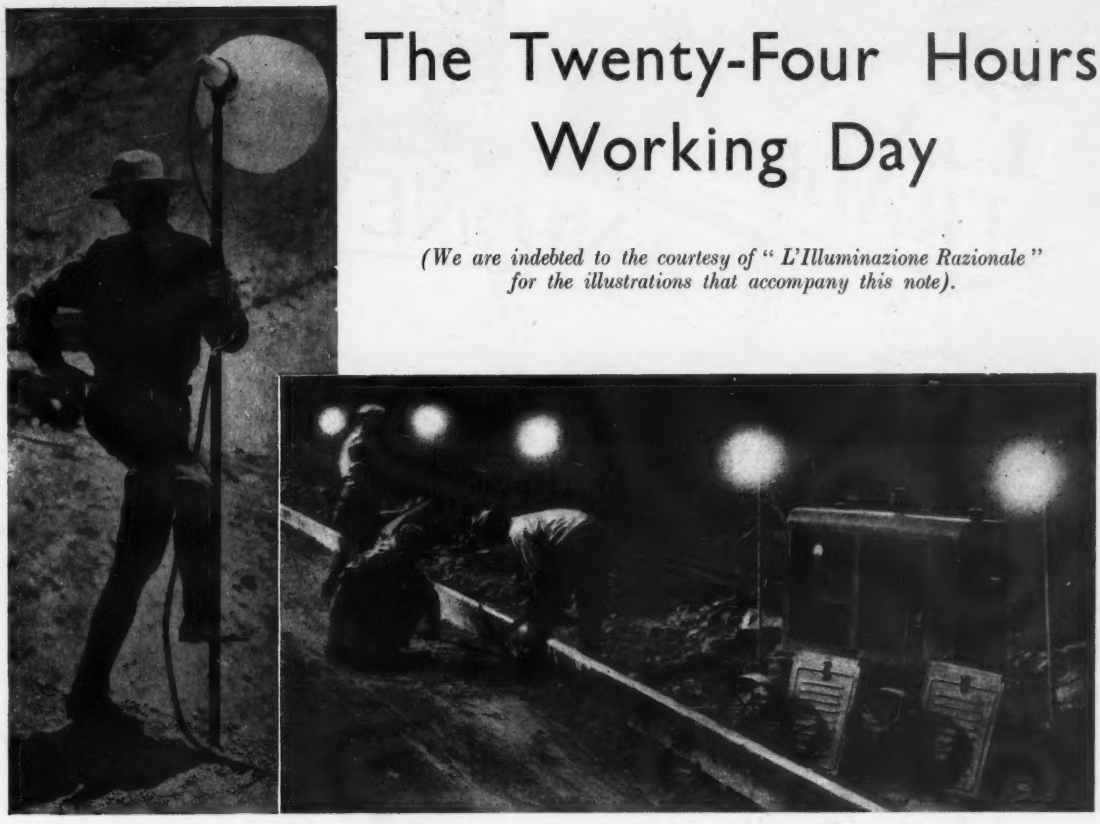
The Stage Setting for "Der Rheingold," showing use of cyclorama with projected stationary clouds and a wonderful picture of the Palace of Valhalla in the background.

A rainbow, serving as a passage of departure for the heroes, bridges the gap between the rocks in the foreground and the distant portal of the Palace.

The projection, as a luminous image, of actual scenery as well as atmospheric effects seems likely to play an important part in scenic effects of the future.

The Twenty-Four Hours Working Day

(We are indebted to the courtesy of "L'Illuminazione Razionale" for the illustrations that accompany this note).



Portable lamps, spaced 16 to 25 feet apart, enable road construction to proceed by night as easily as by day.

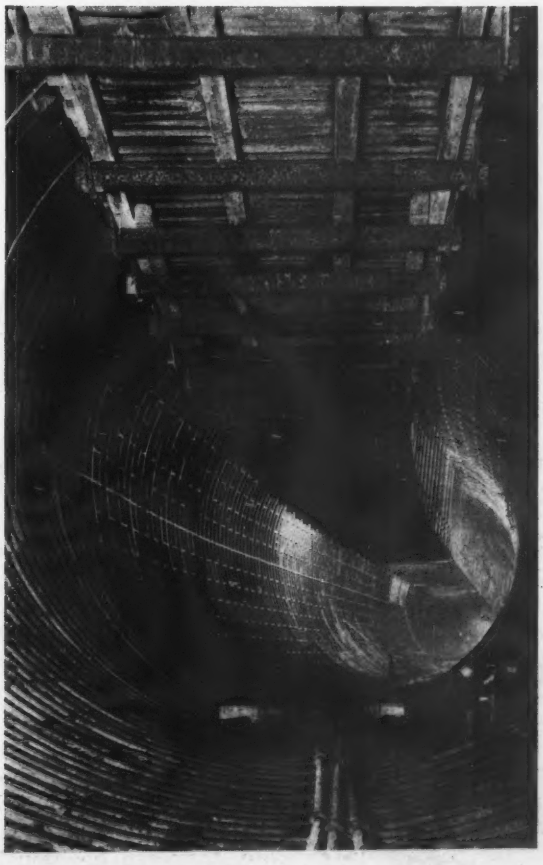
MODERN methods of illumination make possible the operations beneath the earth as well as upon its surface, and the continuous operation of factories—a twenty-four hours' working day.

It is now many years since, in the Premier Diamond Mine in South Africa, a battery of arc light projectors was installed to illuminate the cliff face sufficiently for work to proceed at night and for theft to be prevented.

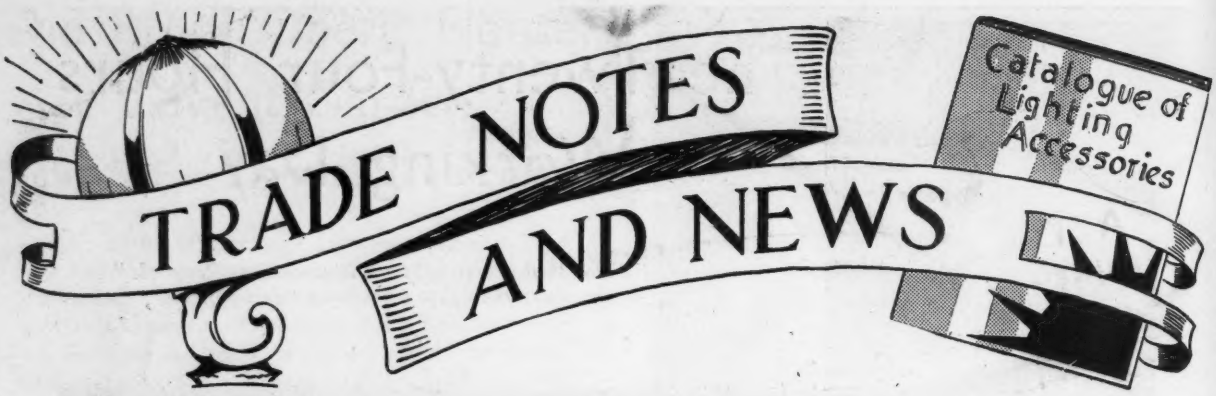
In road and railway work night operations are now practicable. We illustrate above a transportable electric generating equipment which supplies six or eight portable protected lighting units, such as may be spaced 16 to 25 ft. apart on right and left of the working area.

The construction of railway embankments or tracks, the placing of heavy girders in the repair of railway bridges, the formation or repair of docks and weirs, canal building, and river damming—these are some of the heavy engineering works that demand flexible conditions of lighting such as portable projectors can provide.

Tunnels for road and rail traffic are increasing in number and size, and in the complexity of their structural demands. The adjacent picture shows how local projectors, with slightly elevated beams, enable the lining sections to be erected, the roadway completed, and canalisations for conveying water, gas, or electricity to be expeditiously installed.



Large size Projectors are now quite frequently used for the illumination of railway tunnels.

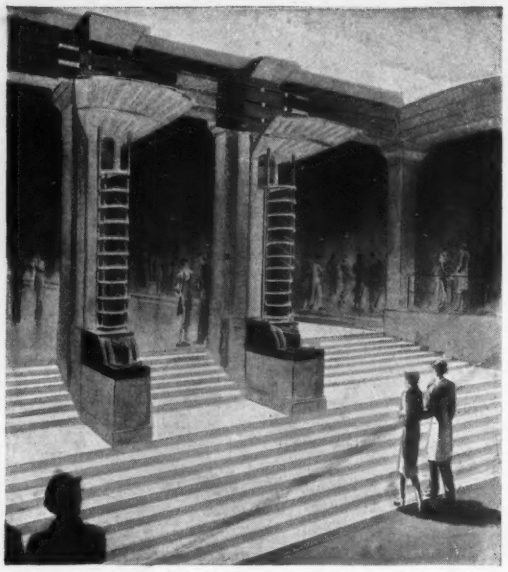


I.M.E.A. Exhibition at Liverpool

E.L.M.A. Lighting Service Bureau's Display

An enterprising departure at the I.M.E.A. Exhibition in St. George's Hall, Liverpool, is the spectacular entrance lighting, which is built up on the existing structure by using architectural tubular lamps.

On either side of the doorway leading to the E.L.M.A. exhibits are luminous diagrams designed to illustrate the towns and districts in Great Britain with 100 per cent. street lighting, the growth and developments of loads involved in the lighting of streets, shops, factories and private houses, and lighting load increases due to rebuilding operations. Other exhibits include demonstrations of lamp quality and the cost of light in comparison with other everyday commodities, and a cinema film illustrating the activities of the bureau. The now famous E.L.M.A. Touring Demonstration Van, which has visited over sixty centres, and given demonstrations and lectures attended by over 8,000 people, was also on show.



Spectacular lighting at the Entrance to the I.M.E.A. Exhibition, arranged by the E.L.M.A. Lighting Service Bureau.

The Mekelite Lamp

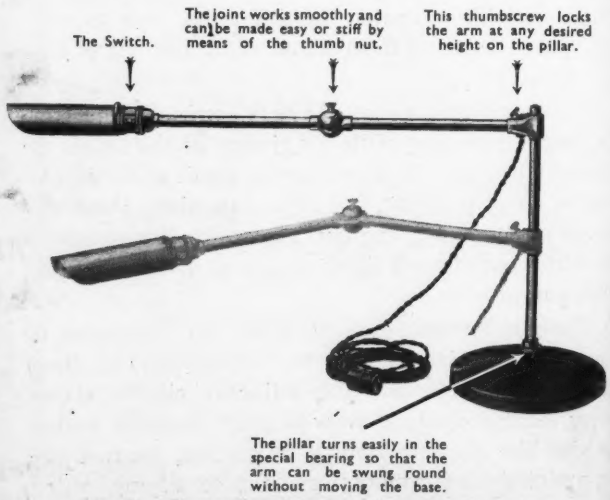
A Simple and Handy Contrivance

There is a general feeling nowadays that whilst good general lighting is almost always necessary in the office and factory, there are many cases in which a well-designed local unit is needed for special work. This applies particularly to inspection processes.

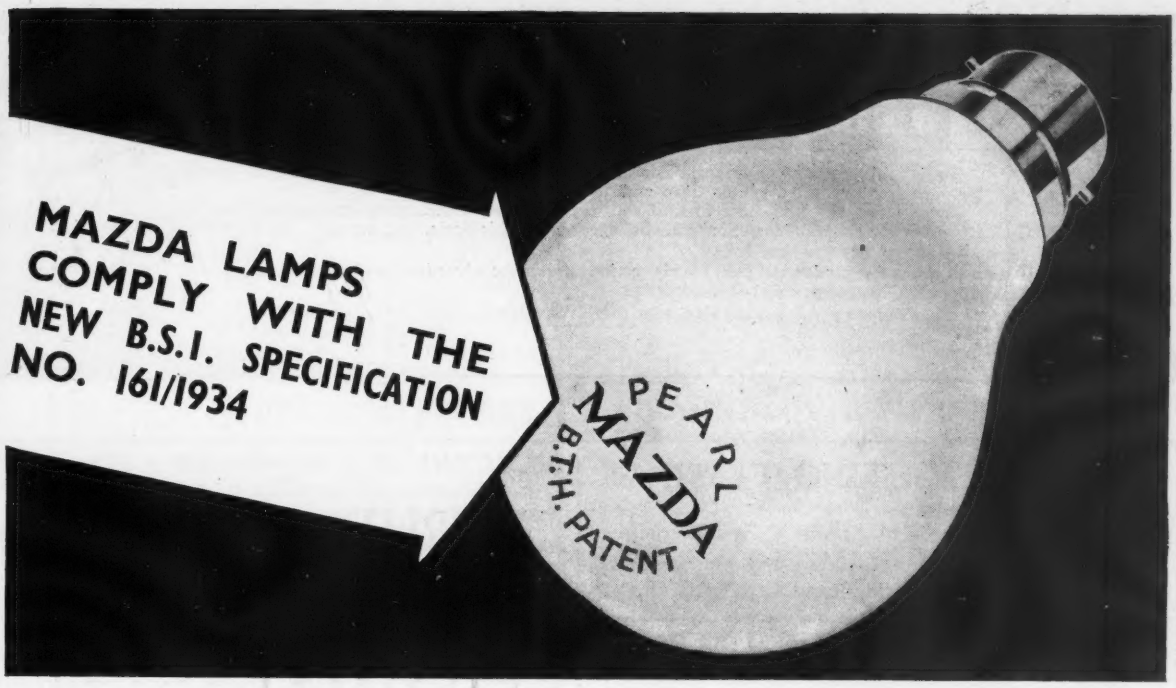
The simple and ingenious lamp here illustrated, which is supplied by the Mek-Elek Engineering Co., Ltd., should often prove useful. The illustration really "explains itself," and illustrates the great flexibility of the design, which is combined with robust construction. (We are informed that a number of these lamps were on view at the Ideal Home Exhibition, where they had to be turned and twisted in every possible way, almost without intermission, for demonstration. None suffered in any way, and no defects developed.)

A feature is the economy of the lamp, for which small 15-watt lamps, with frosted bulbs, are normally used. These compact lamps are completely screened from view by the tubular reflector—an important point. Furthermore, they can be brought very near indeed to the object examined, thus affording the very high illumination necessary for minute inspections by experts and connoisseurs.

The essential principles of the lamp are embodied in a number of other models, some of a simpler character. Accumulators (giving twenty hours' light per charge) are available for use with them in cases where an electric supply is not available.



A self-explanatory general view of the Mekelite Lamp.



Because they are better made, more thoroughly tested and more accurately rated, Mazda Lamps give better lighting service than cheap lamps.

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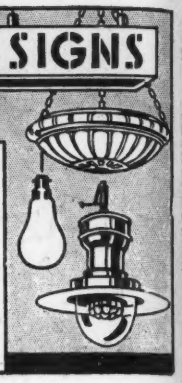

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Fittings at the New Barking Power Station

With reference to the description of the above installation, which appeared in our last issue (ILLUMINATING ENGINEER, May, 1934, pp. 165-166), we have been asked to state that the lighting fittings used were designed by the designing staff of the manufacturers, Messrs. Fredk. Thomas and Co., Ltd.

The New Coiled-Coil Filament Lamp

An Interesting Announcement

(Communicated)

WE are informed that the public will benefit during the autumn from the introduction of a more efficient electric lamp capable of giving 20 per cent. more light for the same energy consumption, and suitable for use in the home and elsewhere, which is the result of extended research on the part of the lamp companies associated with E.L.M.A.

It will be recalled that the gasfilled lamp was originally only available in large sizes, and that it depended for its successful operation upon the filament being operated in an inert gas. The presence of the gas, however, rapidly took heat away from the filament by conduction and convection, and the full value of the gas filling could only be obtained when the filament presented a relatively small surface area to the gas. Therefore, the filament was coiled.

Another point with which the trade is familiar is the fact that efficiencies of gasfilled lamps became less with the smaller sizes. The light output from the 40-watt lamp measured in lumens per watt was little different from that obtained from the corresponding size of vacuum lamp, and it is for this reason that manufacturers delayed for a considerable time any attempt to make 40-watt gasfilled lamps in the smaller sizes; the public, however, demanded the gasfilled lamp in the small sizes in spite of little advantage in efficiency, as the light provided was much whiter and the illumination obtained more effective for visual purposes. It is in the smaller sizes of gasfilled lamps that the new process of coiled coiling will have the greatest effect.

For the next lighting season E.L.M.A. manufacturers will be supplying the 40-watt coiled-coil lamp which will give 20 per cent. more light than the corresponding size of gasfilled lamp made by them, and manufacturers expect that it will be followed within a limited time by the 60-watt size. The lamp is being shown at the E.L.M.A. Lighting Service Bureau Stand at the I.M.E.A. Convention Exhibition in St. George's Hall, Liverpool. It will be supplied in pearl or opal bulbs for voltages 200-260.

Apart from the five million domestic consumers who will immediately benefit by the use of these lamps in obtaining more light, the coiled-coil lamp will make a wide appeal to large users employing architectural methods of lighting.

In the case of the 40-watt size lamp the filament is only few ten-thousandths of an inch in diameter, and it is first of all coiled on a mandril a little more than double the diameter of the filament with the turns 5 ten-thousandths of an inch apart. An error in spacing of the turns of few millionths of an inch would produce an unsatisfactory lamp. This coiled filament is now itself coiled. In the early experimental work the very fineness of the filament made it difficult to apply this process, and efforts were confined solely to the very small projector lamps employed in the home cinema and operated at a relatively low voltage. The greatest possible skill has been necessary to provide a similar filament suitable for a lamp to operate at 230 volts.

The demonstrations staged at Liverpool show the construction of the filament itself, and by means of an integrating sphere photometer the improved light output of the coiled-coil filament lamp, compared with the ordinary gasfilled lamp, is measured.

The Lighting of the Municipal Bank, Birmingham

THE new Birmingham Municipal Bank in Broad-street, Birmingham, is an imposing edifice in a classic style of architecture; and, as the illustration shows, is lighted by enterprising methods.

The spacious loggia is illuminated by means of 50 ft. of specially designed trough, with lampholders at 6-in. centres for use with 100 and 150-watt lamps. This trough is concealed in a recess immediately above the pillars, the front of this recess being fitted with solid bronze frame-work glazed with dewdrop glass of a green tint.

The illumination of the banking hall (Fig. 2) is effected through a large laylight, with small brackets on the walls to serve as pilot lights. The laylight is glazed with amber-coloured dewdrop glass, sand blasted on one side. Installed above it are twenty enamelled steel dispersive reflectors containing 300-watt lamps, thirty similar reflectors with 200-watt lamps, forty similar reflectors with 100-watt lamps, and forty 100-watt lamps in back-plate type holders. The illumination over the whole of the banking counter is approximately 8 foot-candles.

A system of trough reflector is also used in connection with the illumination of the manager's room. The reflectors are concealed by a cornice, and house

The underground Safe Deposit of the new Birmingham Municipal Bank in which trough reflectors equipped with Osram lamps provide the necessary lighting.

15-watt lamps at 6-in. centres, furnishing approximately 7 foot-candles.

A somewhat similar principle of lighting is adopted for the committee-room. In this instance, the trough reflectors are run along two side walls only. This room has a barrel ceiling, so that the effect of the indirectly diffused light is considerably added to, and as the source of the illumination—at the head of the panelling—is screened, the impression given by it is peculiarly intriguing.

The bank's "safe deposit" (Fig. 1) is situated in an underground room, where a large number of miniature safes are let into the four walls. In view of the fact that a close inspection of deposits is often necessary, special attention has been given to the lighting of this room. Over 180 ft. of troughing has been affixed in a recess above the safes, with 40-watt lamps at 12-in. centres, the canted grille of the troughing being glazed with pink-flashed opal glass. In the centre of the room are two illuminated glass pillars around stanchions, and these are equipped with trough fittings carrying 15-watt lamps.

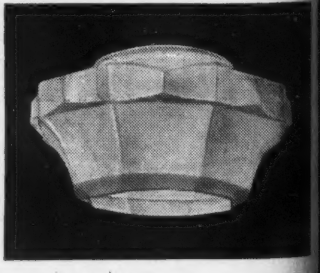
We understand that Osram lamps were used throughout, and that the General Electric Co., Ltd., was also responsible for the lighting fittings.

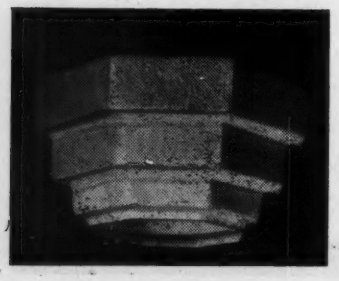
The installation work entailed was carried out by Mr. T. Glover, of Birmingham, in accordance with the plans of the architect, Mr. T. Cecil Howitt, F.R.I.B.A.

The Banking Hall of the Birmingham Municipal Bank, illuminated by means of an electrically illuminated lay-light.

Vitreosil Products

THE VITREOSIL productions of The Thermal Syndicate, Ltd., of Wallsend-on-Tyne, continue to maintain their popularity, both for gas and electric lighting. Several bowls of new design have recently been put on the market. As will be seen from the illustrations here shown, these bowls are modern and artistic in design and of pleasing appearance, either lit or unlit. The Thermal Syndicate issue illustrated literature dealing with these useful globes and bowls, and with their Vitreosil flame-proof lustre cooking ware, which is arousing much popular interest.





The outstanding feature of Vitreosil is, as is well known, its extreme resistance to severe changes of temperature. A striking proof of this was given in connection with the flood-lighting at the gardens, Castleford, during last winter. One of the principal features was the fountain, the centre stem of which was illuminated from within by gas-lamps of 80 c.p., fitted with VITREOSIL globes. The globes certainly steamed as the water fell on them! But they stood up successfully to this severe test, an experience which seems to furnish a hint to those concerned with decorative lighting in exposed out-of-door situations.

We understand that special fittings can be made up where unusual arrangements are under consideration.

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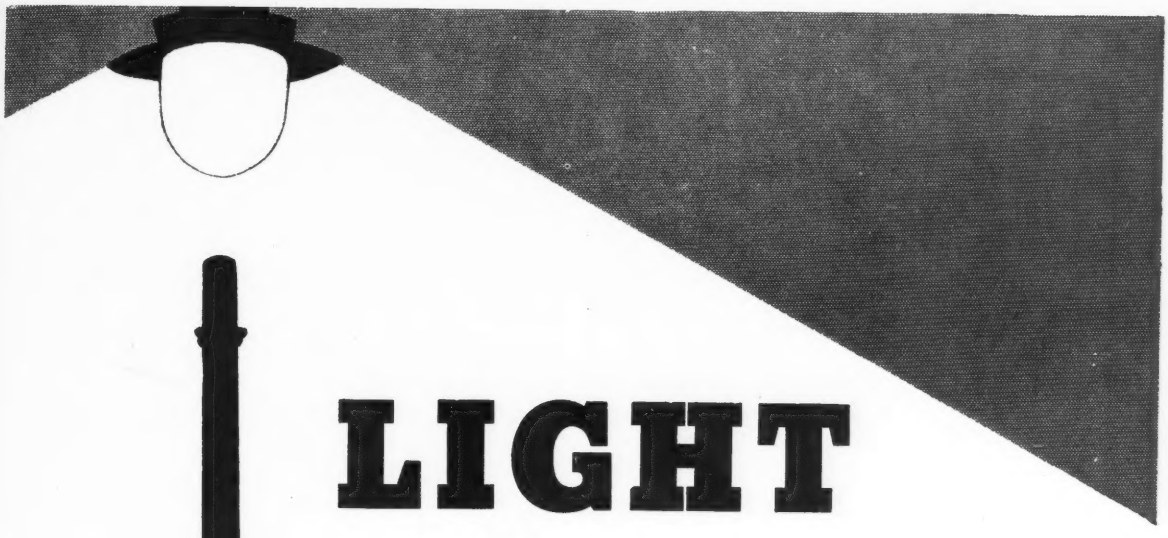

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